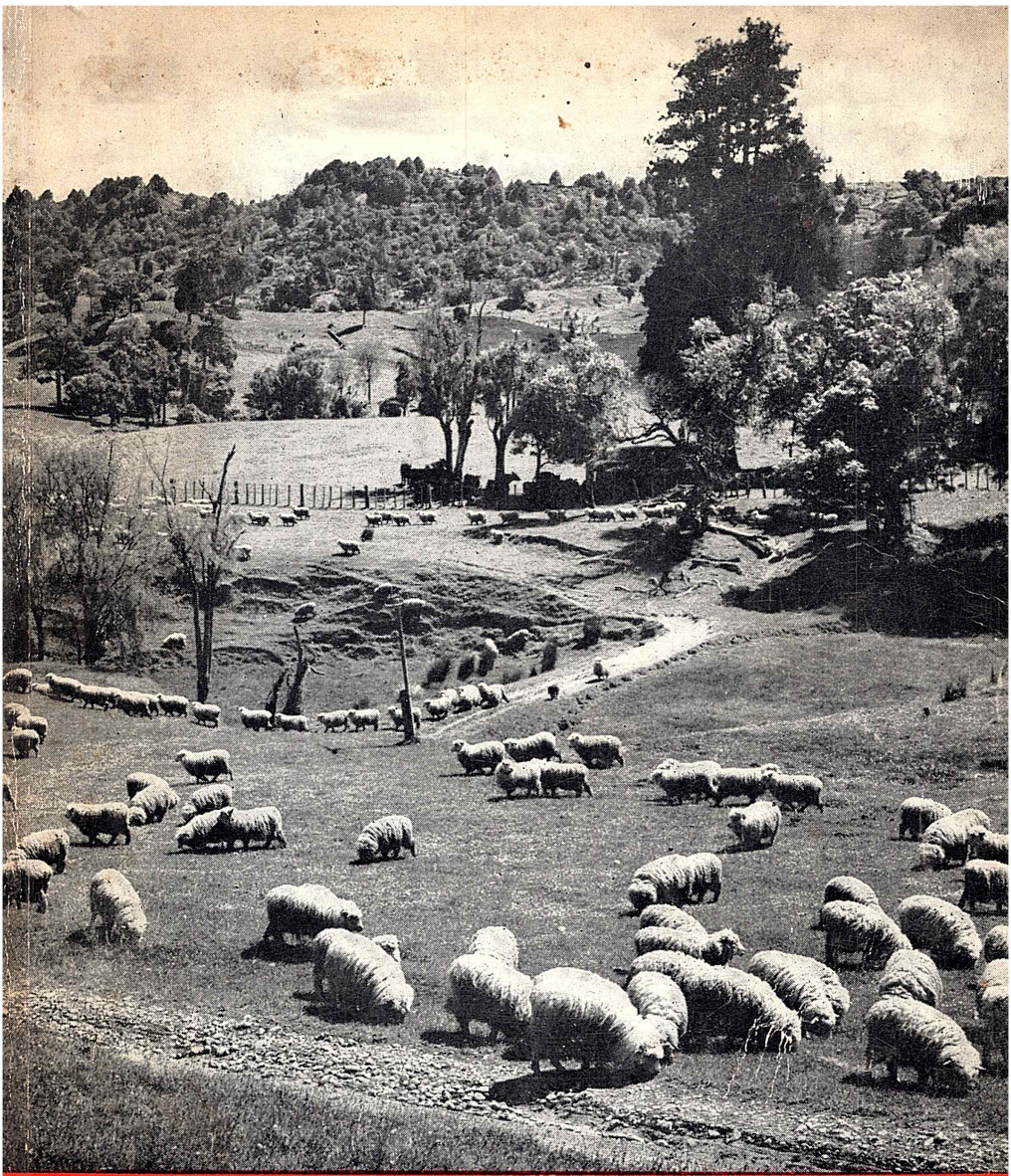

SHEEPFARMING ANNUAL 1963

MASSEY UNIVERSITY COLLEGE

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1963

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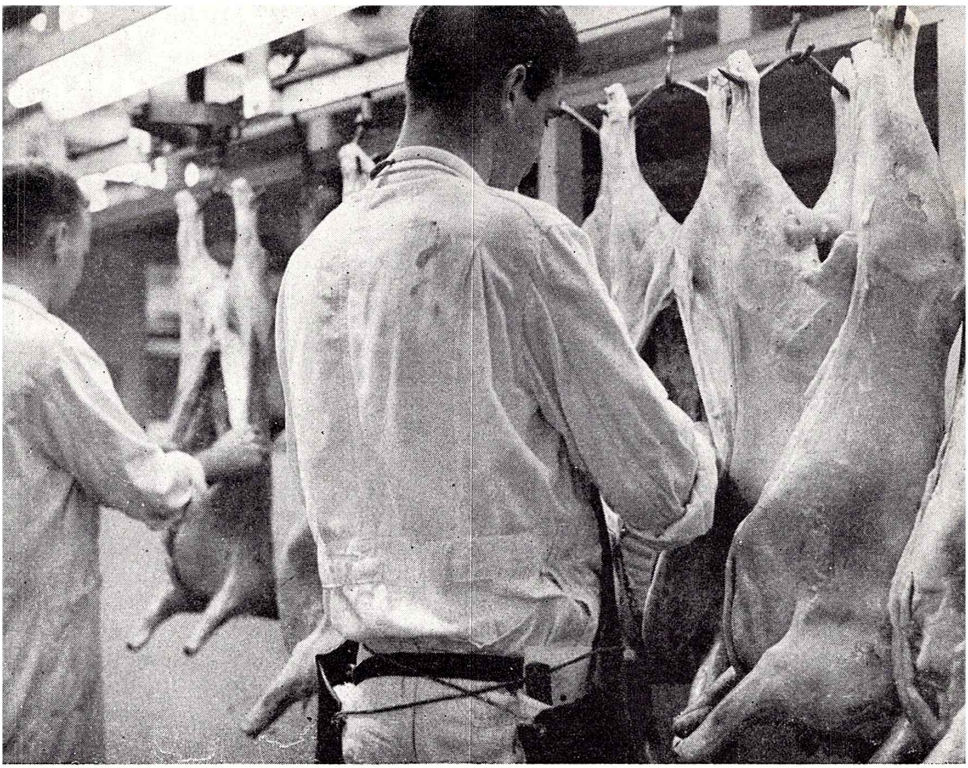

Dept. of Agriculture photo

DIFFICULTIES OF THE COMMODITY AGREEMENT APPROACH FOR MEAT MARKETING

DUNCAN RIDLER*

THE SUITABILITY of an international commodity agreement for meat has been selected as the subject of this paper, because such schemes are in the air, and are being proposed as the right approach to the growing difficulties of international trade in primary products with the advanced industrial countries.

Commodity agreements are multilateral treaties under which the participating government commits itself to some direction or control of the country's trade in the commodity, or in some instances makes a substantial financial contribution to a supra-national authority which enters the market as a regulatory trader. In most commodity agreements, the government has to ensure that the commercial sector operates only within the price or volume limits of the agreement.

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The idea of a wide network of commodity agreements has recently been put forward by a number of major trading countries and by the International Federation of Agricultural Producers. It is therefore an appropriate time to have a clear understanding of the international market situation likely to face meat producers, and whether efforts to work out an agreement would be worth while in the long-term interest of orderly trade expansion.

New Zealand, up to the present, had no vital interest in farm products for which multilateral agreements were negotiated or proposed. Now the international *political* forces pulling New Zealand towards involvement in commodity negotiations of this nature are *apparently* strong. Apparently, because at the same time there have been important moves to tackle trade liberalization afresh — in many respects incompatible with commodity agreements — and political, because the present commodity agreement approach is linked to much wider economic and social issues, such as European integration and anti-Communist policies, quite different from the background of existing agreements. The bargaining position taken by countries may not be determined by the commodity situation alone.

In the past, important trading countries have not been willing to discuss commodity agreements for major temperate products, but over the last twelve months key countries have reversed their attitudes or expressed concrete support. Mr Heath, reporting to the British House of Commons in August, 1962, at a time when it looked as if the E.E.C. negotiations were coming along well, was able to say:

> . . . all the Seven Governments agreed, in the context of an enlarged Community, to take an early initiative to secure world-wide agreements for the principal agricultural products. This decision reflected recognition of the responsibility of the enlarged Community as the most important food importer in the world. In the discussions that have just concluded, Ministers clarified further the purposes of such agreements and amplified the points to be covered in them. The latter would include the price and production policy to be followed by the exporting and importing countries, the minimum and maximum quantities to enter international trade, stock-piling policy and the special aspects of trade with developing countries. . . . It was agreed that such world-wide agreements would be subject to revision every three years.

The United States normally declined to take part in efforts to negotiate commodity agreements, although imports into the United States might dominate the trade

situation. But on this European initiative, the administration modified its policy and expressed American willingness to co-operate, as a means of progress towards a united, democratic and economically dynamic Europe. The United States is now committed to commodity market stabilization.

Last September the Commonwealth Prime Ministers jointly agreed to "support a fresh and vigorous approach to the negotiation of international commodity agreements" to the end of maintaining and expanding world trade and improving the organization of the world market.

Although the enlargement of the Economic Community did not take place, the idea of global agreements has not been shelved. Preparatory study is continuing in GATT and various UN agencies, but evidently some of the impetus has been lost.

The Government and some producer interests have reacted not unfavourably to these developments. The Prime Minister has stated New Zealand's "willingness to join with the countries of the Six, Britain, or any other countries in drawing up satisfactory international commodity arrangements which would provide for the maintenance and expansion of commercial trade and also for the orderly disposal of surpluses". This is perhaps not surprising. The country's farmers have had veteran experience of getting government into the front line on trade issues. There has been great reliance on trade within the framework of bilateral agreement over a long period. It may well be that New Zealand is not averse to wider commodity agreements, provided the advantages can be shown. But the impression is that the support so far is general rather than specific to any other commodity than dairy produce. There has certainly not been a positive follow-up by the New Zealand Meat Producers Board.

There has been no definite suggestion of a commodity agreement for meat, as a priority. Originally, the French authors had grains, dairy produce and beef in mind, because they are crucial production sectors in the Community, and because the enlarged Community area takes the bulk of world imports. Meat may well be the least urgent item on the agenda, partly because the economic outlook does not seem as critical as for wheat and dairy produce. This will be discussed below. It may also be because, even at the outset, before any pre-bargaining

studies are made, it is evident that a meat agreement would be even more ambitious and complicated than the only partially successful commodity agreements it has been possible to bring into force in the past. There are lessons to be learned from previous agreements, but at first sight their aims and techniques would not be suitable, in fundamental ways, to the meat situation. Let us glance at the record of some of these negotiations.

The chief products for which agreements are in operation are wheat, sugar, coffee and tin metal. The provisions have been in force for about three to five years, with the methods of regulation being changed on renewal of agreements, in accordance with experience and changing circumstances. Common to each was the emergence, or serious threat, of a disastrous situation for producers, and consequently a strong incentive to concentrate on stability measures. Each of these agreements attempts to impose controls on trading across frontiers, through export quotas, price fixing, multilateral contracts to guarantee markets and prices, or buffer stocks. In fact, this meant an attack on the symptoms, and not the causes, of maladjustment of supply and demand. Export quotas, for example, can only put off the day of reckoning if the factors causing over-supply continue. And in practice the agreements had a weak influence on the production or consumption trends which were causing the trade situation to get out of balance.

Thus the emphasis on multilateral bargaining since the war was on achieving reasonably stable prices. There was the potent memory of the depression years, the experience of wartime and postwar controls, and, until comparatively recently, the underlying assumption that taking one year with another the international market capacity was there. The theory was that, if the temporary gluts or shortages causing violent price fluctuation could be ironed out or prevented from affecting prices, the market would be satisfactory. In actual operation the Wheat and Tin Agreements seemed to have got the mad market into a straitjacket. But the Sugar Agreement has not worked as well as expected, as is currently well known, and the Director of the International Wheat Council recently said that the apparent effectiveness of the measures was largely due, not to the agreement itself, but to the willingness of major wheat producers to build up national stocks.

Moreover, it becomes more and more obvious that price stability measures are not preventing shrinkage of market

outlets. How much can be traded is more of a preoccupation than prices. Fixed prices, export quotas, buffer stocks, are of little value if imports are not maintained. So that the real danger is of shrinking trade outlets through expanding domestic ouput and of burdensome surpluses in exporters' hands overhanging the current trade. This goes back to the weak influence of agreements in expanding consumption or to restrain long-term over-expansion of production.

No existing international agreement guarantees a fixed volume of future trade. Any agreement which attempted to guarantee market outlets would contain the seeds of its own destruction if long-term output trends are not co-ordinated with the international objective. Even if access to particular markets is guaranteed, what can be done with the excess of domestic output? As has been the experience of dairy farmers here and wheatgrowers elsewhere, there is no lasting solution to a multilateral or bilateral guarantee for one sector of the import trade if it passes the problem on to another sector. This again is the short-term approach, and in fact governments and producer interests have begun to reconsider international commodity problems in two respects.

First, there is greater support for looking ahead. More advantage is being taken of the new techniques of forecasting and of making projections of demand and supply. This involves assessing the results of national policies. Agreement authorities and international organizations are getting more support for such work, even if this implies comment from an outside body on national farm policies and might provide ammunition for one's competitors. This means that eventually there should be better understanding of the causes of trade difficulties, and is indispensable for a co-ordinated policy. A common policy on the basis of forward programming is what the E.E.C. is attempting within a restricted area, and this was a major stumbling block in the United Kingdom negotiations. Secondly, the idea of world trade on two levels, through discrimination, is gaining ground. In essence, the aim is stabilization in high-income markets while preventing injurious disposal of surpluses in other countries. There is also the element of humanitarian concern; making surpluses work in the foreign aid programme. Hence, the seven European governments, and the Commonwealth leaders quoted earlier, agreed to attempt something of this nature, and again the

Kennedy Administration seems to have shifted ground on the thorny old problem of bilateral surplus disposal.

No one would disagree that it is rational to plan ahead in international trade policies, or to get rid of surpluses in ways of most benefit, but it must be clear that neither of these topical interests represents actual progress in the rational use of agricultural resources or the encouragement of efficient production. Forecasts will be useless if they are ignored, and concessional sales can perpetuate uneconomic production.

Now, how does this preamble apply to meat and particularly sheep farmers? An obvious difficulty is that the three years to which most governments seem prepared to commit themselves would not be of most benefit in planning livestock production. Even where producers could in theory plan and complete production in three years, there is, as is well known, a good deal more to the adjustment of the farm management programme than bringing the slaughter stock to maturity, and this would apply especially to grassland management. It is relevant to note that livestock production cycles, a rough indication of time required for changed expectations to work themselves out, up and down, have been measured at 10 years for beef cattle and about 16 years for sheep. *Therefore, any meat arrangements would have to be for a longer period than three years.*

Another general point is that there is no comparison between meat and those types of commodities for which it was found possible to get a practicable working arrangement through international agreement. Meat is a whole group of commodities of diverse origins, stages of processing and complex price structure. Consider only the elementary problem of controlling tonnage under a quota. How many tons of the various products of the pig would equal so many tons of lamb? At least there would be every incentive not to ship waste bone and fat.

The main consideration here is that *regulation cannot generally be made effective where there are close economic substitutes marketed freely. The inference is that an agreement should cover at least beef, pigmeat, mutton and lamb in their main export forms,* and this would still leave large unknown elements of uncontrolled competition, for example, poultry. A wheat exporter can hardly ship bread, instant coffee is counted as beans under the agreement, tin metal is standard enough for a currency base, *but the problem of administering all major meat products would*

be fantastic. On the other hand, if world market regulation were introduced for, say, pigmeat only, it is practically certain that pig producers would be at a great disadvantage against other livestock producers.

These are just technical points. They would apply whatever the trade outlook, but if the actual world market is examined, there are a number of other difficulties.

Commodity agreements have controlled trade, because traded supplies had a major influence on the market situation. Meat is not in this category. *Internationally-traded meat constitutes less than 10% of the consumption of the advanced countries.* The few important exporting countries — Australia and New Zealand, the River Plate countries, and one or two European countries — which supply the bulk of the trade, could hardly hope to find assurance of orderly meat marketing without commitment on the major sources of supply, domestic output which is not traded. New Zealand producers know that they have had little influence on total marketings in the United Kingdom market, despite the dependence on imports for nearly half of these supplies, and despite the fund of goodwill between the two governments. It is suggested that it will be immensely more difficult to persuade a wider group of exporters and importers to agree to regulation of all supplies. Governments have hardly allowed discussion of their national policies, let alone bargaining about them. *But if the aim is to expand New Zealand's markets for meat in high-income markets in line with demand growth, it cannot be done without commitments by importers on their domestic industries.*

The choice in international consultations on meat is between an attempt at market management and the pursuit of trade liberalization and tariff reductions. This is an important decision for New Zealand producers, and raises several questions. Should they settle for an old-fashioned commodity agreement, aiming at short-term price and volume rigidities — if it could be achieved by government regulation, which is uncertain — or should they seek a trading framework which would test their ability to expand at the risk of competition? The answer depends on the production and consumption outlook. If the supply situation is going to get seriously out of balance with demand, surpluses develop and world market prices and volume decline, it might be wise to settle for price and import volume guarantees, and give up the chance of growth.

Further, could it be hoped that nations would be ready to tackle trade liberalization wholeheartedly, or agree to a confrontation of national livestock policies and act on international recommendations? The answer to this is that the atmosphere is now more favourable to serious consultation on meat on these lines with the support of the technique of across-the-board tariff reductions by the contracting parties to GATT, and with the decision there in May, 1963, to negotiate on both tariff and non-tariff barriers on meat. And lastly, what would prevent any country, unable to restrain uneconomic upward trends in meat output, from taking advantage of a more liberal trading framework to dump meat in the world market? Here perhaps one could envisage the need for a properly supervised code of principles, supplementing those already accepted by GATT and FAO members, designed to ensure fair trading practices for meat.

Turning now to the world outlook, a really threatening future has not been noted. The *demand* for meat, looking ahead to 1970, is expected to increase to a much greater extent than wheat, sugar or dairy produce in the high-income countries. FAO estimates growth in the 1960's at about one third*. The consumer still buys substantially more meat as incomes rise or meat becomes relatively cheaper. *Production* in the main meat producing and consuming countries is not expected to outstrip demand as a whole. In short, an expanding market without serious oversupply is foreseen. As regards *trade*, the same authority says that there may be some narrowing of the international market owing to greater home consumption and more self-sufficiency within the European Economic Community. For example, exportable supplies from Argentina and Uruguay are not expected to increase significantly, while exports from Australia and New Zealand are projected only 15 to 20% higher. British imports may be 9 to 14% higher. The creation of the common market for meat in the EEC could lead to a severe decline in net imports; to 40% of the 260 thousand tons required in 1957–59. But if E.E.C. economic growth were 1% a year more than in the 1950's, a rise of 50% in requirements from outside is indicated. The E.E.C. situation is thus unclear; it could be favourable or unfavourable.

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* *Agricultural Commodities — Projections for 1970.* Food and Agriculture Organization, Rome, 1962.

As regards different kinds of meat, the report warns that there could be selling pressure from *beef*, a possible 350 thousand tons in excess of foreseeable demand. But because of growing preference for beef, "the market would probably be cleared through moderate price declines". On the sheep situation it says that "exportable supplies of mutton and lamb might not be sufficient to meet the entire import demand of the high-income areas" under a favourable trend in incomes. It goes on to observe that, in view of the large production potential in Australia and New Zealand, "it is possible that this source would be able to fill the gap without difficulty and also to meet any additional import requirements of outside areas". Presumably this would be excess of the 15 to 20% export expansion estimated.

Such projections are a new exercise and very tentative, but a good deal of research and thought went into them. They should at least be kept in mind when they tend to show a strong market as when a weak market is indicated. Much play has been made by official spokesmen on the ten million ton milk surplus brought out in the same report. *For meat, one fails to see any major features on the hazy horizon of 1970 that warrant pursuit of a rigorous scheme to bind trade within quotas or on prices.* It is to be hoped that the projections will turn out substantially correct. At least, those who advocate commodity agreements should question these forecasts with equally careful research or show why an agreement would assist in this medium-term future. *It seems to be a situation more favourable to competitive marketing by New Zealand exporters.*

The question then remains: what type of international co-operation would be of benefit in the meat situation? *There seem to be two valuable fields for intergovernmental activity — consultation on policies based on objective outlook research, and the trade liberalization negotiations.* Arrangements between governments for both of these activities have functions which complement, and do not replace, those of the industries involved, or the complex marketing systems which work with a fair degree of competition and have evolved to promote dynamic marketing. They would both help to make the international market mechanism more responsive to trends in demand and

supply, and they would also both encourage the fullest use of New Zealand resources for economic livestock production.

In the sphere of trade liberalization, there are good grounds for hoping that a real break-through may be possible. At the GATT meeting last month, the Contracting Parties, as the member governments are called, agreed for the first time to extend negotiations to both tariff and non-tariff barriers on trade in primary products and, in addition, established special groups for meat and dairy produce. These will presumably put up for negotiation to the Contracting Parties, modifications to both tariffs and quantitative restriction on these commodity groups. In addition, the general acceptance of across-the-board or linear tariff reductions, instead of dealing with individual items in turn, could mean that New Zealand could get concessions on primary products in order that Europe gets concessions on industrial goods into America. At the same time, it is to be hoped that the concessions which Europe and Japan will make in order to get United States tariffs lowered in general under the "Kennedy round" will include both quota and duty relaxation on meat. Such concessions will then presumably be bound — *i.e.*, would be irreversible. It is unlikely that these developments are just pious expressions of intention, or that the three special groups — there is also one for wheat — are just further proliferation of committees. Primary producers might now begin to get from GATT some of the benefits it has obtained for exporters of manufactures, and it might therefore be of real help to sheep farmers and a processing industry which are well-placed to benefit from any greater degree of competition.

It is curious that renewed interest in commodity agreements has coincided with this fresh attack on trade restrictions. It shows at least the concern over the problems of primary producers. But one cannot put money on both of these horses to win in the same race. Commodity agreements, unless they are in some quite revolutionary and undiscovered form, at best only aim at freezing the degree of restriction on trade. Hence New Zealand's international objectives for meat should be unambiguous and consistent as they seem to have been — in favour of less restriction — in statements to date by the Government and the Meat Producers Board.

This raises the pending issue of quota restrictions on the United Kingdom market — a control that would be equivalent in scope to an international commodity agree-

ment. It is particularly disappointing that, in the very same week of the development in GATT, to which the United Kingdom agreed, the Government should also announce its desire to control imports. Was this a case of the Board of Trade not knowing what the Ministry of Agriculture was doing? The writer's opinion is that quotas on mutton and lamb are not justified by the outlook for the British market; that they might in practice not be restrictive. They are probably being put forward as political treacle with the brimstone of a ceiling to subsidies, or even as an alibi on the good intentions of the Ministry when the ceiling is imposed, whether quotas are accepted or not. What is relevant in the present context is that acceptance of quotas in the major sector of world meat markets would greatly weaken the forces pressing for liberalization in GATT. It would make it more difficult to challenge the intention of the E.E.C. not to bind tariffs on meat, but to slide them upwards by variable import levies, in order to maintain effective control on the quantity of meat imported. If formal controls are accepted for the British market, it becomes difficult to argue for the removal of restriction in Japan and Italy, both potentially major consumers of imported mutton or lamb.

The conclusion, then, is that New Zealand should continue to bargain exclusively for the removal of barriers to meat trade, should not participate in either bilateral or multilateral commodity arrangements unless they are unequivocally drafted to guarantee a greater trade, and should be prepared to make some import concessions also in the expectation of getting a much greater incidental profit from other countries' concessions across-the-board in GATT.

In conclusion, a subject might be briefly discussed which, perhaps understandably, is of very little interest to the individual farmer — economic analysis of world livestock trends and confrontation of national policies. These matters are too remote from the farm firm, the main concern is with current market features, and consequently fundamental economic research in a broad international frame has been sadly neglected.

Some important meat issues are discussed internationally by teams wearing blinkers and wrongly fitted spectacles. They cannot see the other members of the team or very far ahead. This is not the fault of the officials or the producer representatives involved. They lack intelligence

in the military sense. It is perhaps not too naive to believe that *compromise on trade difficulties would be easier if the results of trends and policies are better understood by the parties.*

As international commodity meetings became common, two types of economic research were evolved as aids — *techniques for forecasting the medium- or long-term outlook, and analysis of the international repercussions of national policies. This has become the most useful basic economic tool demanded for international commodity consultations and such enquiries can be of great value to individual countries.* As examples, the studies of long-term energy requirements in Europe have influenced the direction of public and private investment in oil and natural gas, while the realization of the probable magnitude of the dairy surplus by 1970 is undoubtedly influencing national dairy programmes and lending urgency to New Zealand's market development activity.

This kind of commodity analysis and outlook work is lagging behind for the livestock industries. Almost all meat commodity intelligence is short-term. One has only to consider the exceptionally prominent coverage of economic news by New Zealand journals and newspapers, to check this. Undoubtedly, when the Monetary and Economic Council recommended in its last report that targets be set for meat and wool exports as a basis for planning in the industry, and to support a 4% growth rate in the economy, it was implied that such targets be realistic in relation to the world outlook. But until world outlook studies for meat are available, the reliability of national targets as a guide to the industry would be impaired. The FAO report, which was referred to earlier, is the first and a very cautious attempt to embrace all major sectors of the world meat situation.

The most objective and cheapest way to plan continuing economic review is not in the Government or in the Meat Producers Board. All but the very largest countries cannot find the staff resources for this type of study, nor can it be undertaken as effectively as in an international secretariat with expert national delegates to plan and take responsibility for the work. It is a valid field for international co-operation, unanimously supported by other producers. Arrangements for international enquiries of this kind for meat could be of much advantage to pro-

ducers. Because of the limited number of countries with a substantial international interest in meat, the membership would not be unwieldy. Unfortunately, the Commonwealth Economic Committee cannot under its terms of reference undertake forward-looking studies, and the GATT is primarily concerned with restrictions on trade. The work of FAO could be the nucleus, but it is not so important how this is organized as that *New Zealand and other meat exporters have the benefit of objective and detailed studies on the outlook for meat production, trade, consumption and prices, when involved in trade liberalization negotiations and as guidelines for development.* International collaboration of this kind is not as spectacular as a commodity agreement or a tariff negotiation, but in the long run it will contribute as much to a prosperous industry.

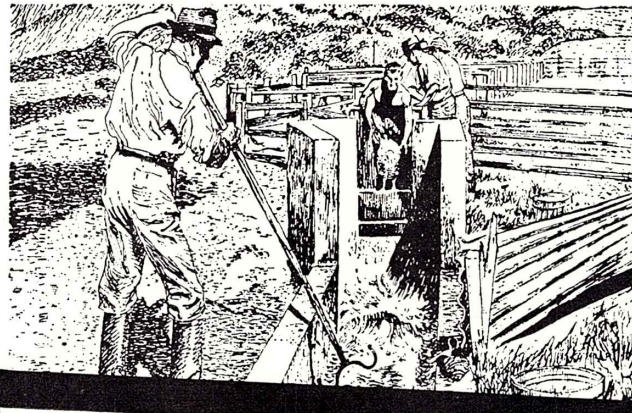
DISCUSSION

Q:: *It has been reported that New Zealand mutton is being sold in Japan at the equivalent of approximately 4s. per pound. Can Mr Ridler explain why the producer in New Zealand should be paid only 3d. or 4d. per pound?*

A:: I could not say which are the most significant factors if the processing cost and marketing margin are so high. This would illustrate the need, if the demand potential at the farm gate and from New Zealand is to be realized, of following-up marketing practices from the stage when the product is sold by the New Zealand owner, and assisting in their improvement.

Q:: *How does Mr Ridler's statement on the outlook for mutton and lamb relate to these separately?*

A:: The statistical information on mutton and lamb separately is inadequate, especially in the United Kingdom. The projection I mentioned for the United Kingdom would probably mean an expansion in lamb. Elsewhere, the forecasts would seem to indicate mutton rather than lamb expansion. As I said, these questions can be answered only when there are detailed outlook studies.



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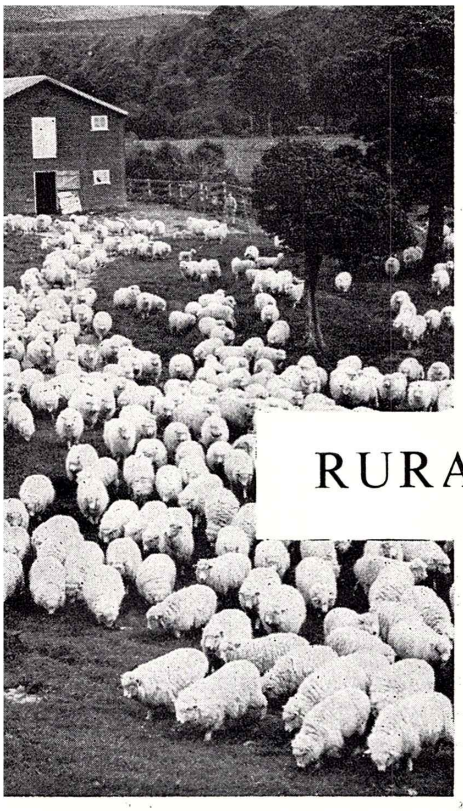


RURAL FINANCE

H. M. CASELBERG*

IT IS CURRENTLY FASHIONABLE to talk about the plight of the farmer and Professor B. P. Philpott made the headlines recently by stating that an investment of £40 million in New Zealand agriculture would earn the country more overseas exchange than the same amount of money invested in secondary industry. He is reported as advocating farmer incentives of varying kinds. There are other knowledgeable people who are alarmed at the trends which have been inherent in the situation facing farming for some time; these trends are now both apparent and somewhat disturbing. In 1961, talking to a "Farming as a Business" session at Lincoln College, the writer said, "Lacking capital, suffering heavy taxation with death duties punitive, and the lack of skilled labour a problem, many farmers feel that it is not worth while to try to increase production. There is no longer the climate of confidence of the 1950s and there is a definite slowing down of the rate of expansion in our primary industries". The situation has altered somewhat since then; some factors are more favourable, some not as favourable. The New Zealand economy generally is better.

* *Dalgety and N.Z. Loan Co., Wellington.*

There has been some alleviation in the tax position, but unfortunately the disincentives remain in farming to the extent that, unless they are removed, in whole or in part, the situation will soon become so serious that it must affect the whole nation, and not only the farming sector. An attempt will be made in this paper to present the situation of farming today, the effect this situation is likely to have, not only on the farming sector, but also on every other section of the community, and finally to suggest some remedies for consideration.

It must be emphasized again that these problems are national problems, and that they are likely — because of this country's narrow and very vulnerable economy — to have an adverse national effect, and that it is only the effort of the nation that can be effective in meeting the situation. It is a situation, moreover, so serious, so threatening to New Zealanders' very way of life, that it transcends party politics or sectional interests. The solutions will require new thinking and a vigorous approach quite different from many of the traditional ideas and traditional methods.

Production Today — Costs and Returns

There is possibly no way of ascertaining the total indebtedness of farmers in this country, but there are sufficient figures available to illustrate trends which are well known in farming circles and are gradually becoming known to the public. Those which follow relate to a five-year period whenever possible. The data for the 1957–58 to 1961–62 seasons are taken from figures published by the Government Statistician, the Meat and Wool Boards' Economic Service, producer boards, or the Reserve Bank.

Production

Volume of Production	*Year*	*Value*
100	1957–58	100
113	1961–62	100

Costs

Farm Working Costs (5 yr)	Increase approximately (sheep)	8%
	Increase approximately (dairy)	6½%
1949–50		100
1961–62		151

(Estimates: Meat and Wool Boards' Economic Service)

Investable Surplus per Sheep Wintered

Year	*Amount*
1953–54	14s. 1d.
1955–56	3s. 5d.
1958–59	2s. 9d.
1960–61	1s. 0d.
1961–62	2s. 2d.

Quantity and Value of Lamb Exports

1957 ..... 197,000 tons @ £198 per ton realized £39 million
1961 ..... 270,000 tons @ £148 per ton realized £39.9 million
(It is the dual-purpose sheep, producing both meat and wool, that has enabled sheep numbers to expand.)

Milk Products

Total milk products realized:

Year	*Amount £ million*
1959	85
1960	91
1961	69.4
1962	73

INCOME (Sheep)

In a paper to the Institute of Agricultural Science, Keen showed graphically that the net income of 25s. per sheep in 1950 has been reduced to 10s. per sheep in 1962 in terms of purchasing power.

CONCLUSIONS

There is sufficient information in these figures to show that income is down and that costs are rising, so that the rate of the expansion of production has lessened to the extent that it will not cater for the rise in population. The effects are not immediately visible. Farms take time to "run down" and a much longer time is necessary to bring them back again into production.

OTHER COSTS

Rates and land tax are up 23.7% over 5 years; interest, electric power costs, meat processing charges have all risen; wool handling charges and levy are up; freight (internal and external) charges are up.

Farmers' Indebtedness

(a) SHORT TERM: BANKS AND STOCK FIRMS

From 1959 to 1962 (having regard to the then deposits and credit accounts), stock and station companies' advances to farmers have risen £21 million. The December, 1962, figures were (total): Banks, £27 million; stock firms, £43.52 million. (Stock firms appear to carry about 30% more than the banks. However, bank advances to stock firms rose £10.4 million, and the reduction in the credit balances was £2.6 million.)

An indication of the situation in the dairy industry is illustrated by the outstanding advances to farmers of one large company. In June, 1958, it was £549,000, and in June, 1962, it was £1,069,000.

A small survey of all types of farms has been carried out and shows a rise in debt over the last three years of about 6½%.

(b) LONG TERM

There are no figures of total indebtedness. The income figures assessed by the Government Statistician and producer boards are compiled on different bases, particularly in respect of interest on capital. The Meat and Wool Boards' Economic Service, in their random survey of sheep-farmers' indebtedness, shows:

Year	*Hill Country*	*Fat Lamb*
1956–57	£6,489	£4,803
1961–62	£9,793	£5,853 (prelim.)

These figures relate nearly to the same farms.

(c) MORTGAGES REGISTERED (RURAL)

Source	*No.*	*Value of Mortgages £(000)*	*Values as % of Total*
Government	2,015	12,348	23.8
Local authorities	12	74	0.1
Trading banks	1,102	153	0.3
Trustee savings banks	213	1,000	1.9
Building societies	466	1,305	2.5
Insurance companies	609	7,198	13.8
Private individuals	4,721	22,789	43.8
All other	1,390	7,106	13.7
Total	10,528	51,973	100.0

(Source: Department of Statistics)

(d) STATE ADVANCES CORPORATION ADVANCES (LONG TERM)

Year	*% Rural Advances to Total*	*% Urban Advances to Total*
1937	56.9	43.1
1952	53.6	46.4
1957	33.0	67.0
1961	19.7 (£8,161,092)	80.3 (£41,506,426)

(e) MARGINAL LANDS

Loans made average about £350,000 per annum to something less than 100 farmers per annum.

CONCLUSIONS

Debts have increased and, although there are no accurate figures available long term, the short term on demand liabilities have now become an embarrassment.

In the ten years prior to 1963 costs rose 21% on sheep and about 20% on dairy farms. In the five years 1957 to 1962, volume rose 12% / 15%. In 1961–62 volume rose 2% and gross farm income fell by about 4%.

There is further ample evidence not elaborated on in the figures above that rise in the volume of production is slowing down.

Population and Labour

POPULATION AND SCHOOL LEAVERS

Population in 1960 was 2,345,602; the projected population for 1970 is about 3,000,000, a rise of 654,000. School leaving numbers are steadily rising; in 1960 they were 58,300; the projected numbers for 1970 are 86,000, a rise of 27,700.

LABOUR FORCE

In April, 1962, the New Zealand labour force was 919,000, of which 128,000 were directly engaged on farms.

For every 100 on farms, 65 were in building and construction; 186 were in manufacturing; and 355 were in the servicing industries, many of which are closely connected with farming.

In the period 1950 to 1962, the total labour force rose by 184,600 persons, allowing for the drop in the farm labour force of 5,700 persons.

The interesting feature is the rise in the tertiary (or servicing) industries of 134,600 at the time that secondary rose 55,700 persons, and farming fell by 5,700, which is somewhat in line with world trends.

CONCLUSIONS

There will be many more mouths to feed.

To maintain the present standard of living and a reasonably full employment programme, the rate of increase of primary production must be stepped up. (In Liverpool, in the United Kingdom, there were recently 15 lads and 10 girls for each available job. In Manchester 4,300 teenagers were placed; 1,000 lads and 750 girls were unplaced.)

The available figures of the indebtedness of farmers are meagre and unsatisfactory, and, in some respects, misleading. Those of the Government Statistician, for example, take no cognizance of interest on capital as a deduction; those of the producer boards do.

The economic efficiency of an enterprise is judged by the yield on the capital employed in it. It is agreed by a number of people who should know that the yield obtained by most farmers is about 3%, and no less a person than

the Secretary of the Treasury says so in respect of sheep farmers' incomes over the last three years (*Dominion*, May 14, 1963).

The Need for Increased Production

It has always been a somewhat controversial point as to whether an endeavour should or should not be made to increase production. Thinking people always ask the awkward questions, "Why, how, and in what commodities?" However, there is probably no one who could have foreseen that the rise in production of practically all primary produce over the last decade would have been sold as it has been sold, leaving New Zealand today as one of the few countries with no real surplus on its hands.

So, without doubt, the first question to be resolved in this country is whether there is national agreement on the necessity for increased primary production. If it is agreed that it is essential, something more than just talking should be done about it. That it will be a difficult exercise which requires a planned approach and bold action is quite obvious.

Some Reasons why New Zealand should Continue to Raise Primary Production

(1) STRATEGICAL ASPECT

If the world situation and in particular the situation in the Far East is studied, the word "survival" automatically springs to mind. The need for New Zealand to increase her population, and to assist those countries, particularly in the East, to raise their standards of living and to withstand communism, seems obvious.

(2) SOCIOLOGICAL ASPECT

The price of power in a democracy is responsibility for the public good — not for the good of any section or sections of the community, but responsibility for the good of every citizen honestly willing to work. It is the responsibility of the State to make available to children the opportunity for general education, while the opportunity for higher education shoud be available for those likely to grasp it and benefit by it. Finally, there is a responsibility to see that a job is available for all who leave school or university.

It appears obvious, then, that if full employment is to be maintained, every economic industry must expand. In a

favourable climate farming would take more employees and it is important to note that increased farm production finds servicing employment for many in the towns.

(3) ECONOMIC ASPECT

It is generally accepted that the greatest responsibility of an owner or a manager of any business is to ensure that it succeeds. What does success in business really mean?

It might be suggested that it means that through an efficient and contented staff a reliable service at a cost acceptable to the public is provided; that the social responsibility any business owes to the nation is accepted; that sufficient profit is made to reward shareholders adequately, and that at the same time depreciation and obsolescence are catered for, along with gradual, soundly-planned expansion. Where such is the rule, Government also is economically sound and able to cater for ever-growing needs. Profit for the individual and for the business is therefore of paramount importance to the nation; and in that profit, provision must be made for the efficient working of capital and labour to provide for future expansion for both the business and the nation. Many believe that success of this kind is the biggest bulwark that democracy has against communism.

There will be general agreement that the welfare of New Zealand depends (short term at least), on the overseas exchange earned by her primary industries, and these are slowing down.

Every thinking person welcomes the recent Export Development Conference — every thinking person realizes that economic secondary industries in this country must be developed. Study of A. P. O'Shea's address to the Nelson Provincial Conference of Federated Farmers (May 30, 1962) will repay reading. He said, in essence, that it is time to do more than talk; that New Zealand has one of the slowest rates of economic growth in the world; that he is in favour of economic secondary industries; that profit in business is fundamental and that despite the most efficient sheep industry in the world, the return on New Zealand capital is about 3% on the capital employed; that trial-and-error methods should give way to positive objectives, and plans to achieve them.

Recently, R. R. Trotter, at Ruakura, gave a thoughtful address with a similar theme and with eight final suggestions that will also repay study. They are mainly in line with those proposed later in this paper.

It was interesting to read the statement by Mr Holley, Acting President of the Associated Chambers of Commerce (*Dominion*, June 13, 1963): "Greater production at lower cost should be our constant aim and this could be accomplished if it was possible to obtain a firm and definite statement and plan from the Government of the day, on incentives to all producers. Much has been said . . . about the need for incentives, but a positive plan is urgently needed so that all can benefit from increased production. . . . High cost of land, the difficulty of finance and repayment is undoubtedly restricting returns to those who have taken up farms in recent years, but surely Federated Farmers and interested Government departments could get together to encourage maximum use of farms at present occupied. . . ."

The fourth report of the Monetary and Economic Council and, in addition, the recommendations of many of the economists, all lead to the one inescapable conclusion — the farming industry needs a shot in the arm. This remark, however, should not be aggrandized out of its context. The farming industry is soundly based and efficient; but there is need to examine why it is slowing down.

Farmers in New Zealand seem to fall into six financial categories:

(1) Those farmers who, for one reason or another, have little debt but have now no incentive to increase production for, as they think, the benefit of the State's income and/or death duties.
(2) Those in the first category, but who are doing some development without borrowing.
(3) Those farmers who have the character, integrity and skill with which to obtain credit for a development programme, but who have not the confidence nor the desire to borrow.
(4) Those in the third category, but who do develop by borrowing.
(5) Those farmers with the character, integrity and skill who do desire to increase production on economic units (or on units that could be made economic with present-day techniques) but who are so badly financed short term/long term, or have such heavy debts, that they cannot immediately raise further finance.
(6) Those farmers who either do not breed confidence or who are on such uneconomic units through physical or through other economic considerations that no one in their proper senses would finance them for the further development of their farms.

The Steps to Increased Production

If these are correct categories, and if, for the reasons given earlier, it is decided that primary production must be increased, what must be done?

The first step is to ensure that farmers do their homework. It is inconceivable that this very difficult exercise should be left to *ad hoc* action off the cuff. This phase should not be glossed over, or any action and any incentives will fail.

The second step is to convince the urban dweller whatever he may be — worker, businessman, self-employed, or public servant — that his welfare and the welfare of his family are inextricably bound up in the foreseeable future with the welfare of, and the planned expansion of the production of the farmer.

Thirdly, it is essential to create a climate of confidence and a climate of urgency in everyone and in the farmer in particular. To do this, the present fragmentation of interest — *e.g.*, Town versus Country, Sheep versus Dairy, Manufacturers versus Farming, Producer Board versus Producer Board — must be unified.

Everyone must be convinced that certain things must be done because of certain reasons, and that a plan which should be acceptable to all classes of the community has been worked out after being carefully considered by their representatives and can be implemented by farmers with their help and the help of the Government.

There then remains the motivation of those farmers in all but category 6 (the unfinancial ones). For those in this category something should also be done, for their good and for the good of the nation.

It will be necessary to convince all classes that complacency, apathy and timidity have no place, that apparent temporary advantages in some fields, or slight hurts in others, may have to be accepted in the interests of the people as a whole.

If it is assumed that the Government and the people agree that there is need for a planned and steadily increasing volume of primary production, what action should be taken?

The first step would be for the Government to set up fact-finding working parties to examine the facts, come to certain conclusions, and make recommendations.

The next step would be to call a conference as suggested by Mr Trotter, at Ruakura, and on the lines of the recent Export Development Conference. Matters on which

work should be done prior to this conference appear to be:

(1) *Markets and marketing* (short-term and long-term), with an examination of the probable demands for produce.

It seems obvious that the producer boards and the Department of Industries and Commerce must come closer together. There is an urgent need for the proper training of future overseas representatives of both the boards and the Department. This is an attractive, exciting career for people of high character and attainment who are basically salesmen, and who are willing and able to learn the language of another country. The projected rise in world population, country by country, would need examination. The figures are staggering.

(2) *Present production* and its relationship to (1).

(3) *Needs for the future,* (a) for the earning of overseas funds; (b) to match increased production to market capacity; and (c) in modern developments in merchandizing.

(4) *How to meet these needs in the most economic manner*: It would be necessary to consider finance and incentives under this heading and they could perhaps be considered here in some detail.

Motivation, first of the farmer, and then of industry, and finally of the whole country, is essential. The farmers on whom New Zealand depends most for increased production are those listed in categories 1 to 4. Some do not need to borrow money, so the only incentive to this group lies in some tax and death duty alleviation. Some do need to borrow and there should be no great difficulty in their doing so if the plan provides for this need.

Category 5 is important. These farmers not only need the incentives of the other groups, but would also require to borrow on reasonable terms.

In respect of the last category, No. 6, it is long past the time that efforts were made by Government to negotiate out farmers on really uneconomic units. The land could be made available for other farmers who could prove that they need extra land and have the skill to work it to advantage. This was done with great success for the 1914–18 ex-servicemen, and did not cost a great deal. If the resultant increased production over the years is taken into account, the cost was very small indeed and, in addition, a number of depressed people were more happily re-established in a better environment.

(5) *Tax and Death Duties.* There have been many suggestions in respect of these contentious taxes and they will not be discussed in this paper. A great deal of work would first need to be done by the responsible working party before a conclusion could be reached. This work should proceed in time for recommendations to be placed before the proposed Conference.

From that point on, the whole campaign would rest largely on Government's approach to the matter, and a way might be found of making it financially worth while once again for a farmer to increase production.

(6) *Motivation of the Farmer*: At the beginning of World War 2, New Zealand required additional wheat, eggs, dairy produce, meat, wool, and other primary produce. These extra goods were produced. The State Advances Corporation was empowered to make loans to farmers to enable this to be done and it was surprising how little finance was, in fact, required. Despite the grumbling of the farmers, they worked for the war effort.

At present there is a crisis almost as grave — certainly not the immediate misery and sorrow, but the threat of it is there. The future belongs to those who plan for it. The present combination of circumstances which has slowed up the industry has brought with it a complacency and almost an apathy on the part of many who could help. If Government, with the help of the farmers, created a climate whereby things could be done to the advantage, not only of the farmer, but also of the nation, they would be done. Almost certainly, they would be done best as local efforts. Targets would be established and quotas given to districts in a zonal development drive, so that the extra production quota came from the district best able to produce it.

Help would be needed from research, extension workers, and others. Individual assistance would need to be given to farmers who required it to plan, programme, and budget so that they could be sure that physically and financially they were able to complete the programme. Programmes for those who needed to borrow would have to take cognizance of finance and the most efficient method on the particular farm of raising production. In many cases, having regard to the labour position on farms, it would be essential that the programme did not lead into heavy, unwarranted, capital expenditure. In many instances consideration would have to be given to an increase in dry sheep and/or cattle,

with an eye on the extra labour that would be required in a different type of plan.

There is urgent need for a permanent planning authority. One way, and there are many, would be to ask for the re-creation of an Executive Commission of Agriculture. The members, instead of being part-time, would be full-time officers serviced by an adequate staff to meet the demands of the scheme. They could co-ordinate the activities of the various boards and consult with the Wheat Committee, the Tobacco Board and all the other boards and committees dealing with the production of farm produce.

(7) *Finance.* At present there is too much short-term and too little long-term finance in the farming community, and no drive can be successful unless this problem is tackled. State Advances Corporation policy — and it is the major rural lender — has been diverted from farm finance by Government policy. Its loan limits are low; normally it will not refinance. The Marginal Lands vote is not very large, but they have not turned down any reasonable proposition — an indication that farmers are perhaps in no mood to borrow. They do not normally refinance either, and this could be an inhibiting factor.

Some organizations and farmers' representatives are clamouring for a rural bank. A liberalization and some alteration in Government policy might have met the situation without the expense of another organization, notwithstanding the criticism of the State Advances Corporation that neither it nor its Minister are sufficiently interested in the rural side, and that rural lending is a specialist job and not to be confused with urban dwellings, tourist and other hotels, and businesses.

Nevertheless, the State Advances Corporation has the administrative machinery and the staff to deal with the matter if it were Government policy for it to do so. In most other countries Governments do guarantee banks or other overdraft advances for specified projects. This approach could be examined.

There might be a case for some new organization which would specifically find the finance for approved programmes of development by arrangement with existing mortgagees. In any case, there is a need for the conversion of much of the short-term indebtedness to long-term finance within the bounds of prudent lending. Should this be done by a new organization, or is it possible to so arrange policy that existing organizations could do it?

Conclusions

(1) New Zealand's exports need to be expanded by £15 to £20 million per annum to meet the demand for overseas funds. Such increase must come from primary industries.

(2) Population and school-leavers in New Zealand are steadily rising in numbers and are likely to continue to do so. Unless the exportable surplus rises in proportion, and terms of trade remain static, the country's standard of living must fall.

(3) Farm production is slowing up largely because, in the final analysis, there has not been sufficient surplus income to plough back into it. Skilled labour is difficult to obtain and to keep, owing to the competitive attraction of the urban life.

The causes for the disturbing trends in the situation facing farming today may be summarized as follows:

(a) Poorly planned finance, long-term/short term on the part of many farmers in the buoyant 1950's, which retards progress today.

(b) The clinging by some farmers to a standard of living that is not being earned, at the expense of maintenance and development.

(c) Taxation and death duties.

(d) The difficulty of financing farming development.

(e) The lack of leadership and clearly defined targets — no drive towards objectives which are appreciated and understood.

Sequence of Possible Action to Clarify the Position

(1) Study of the situation organized by Government through the Director-General of Agriculture.

(2) Setting up of working parties, embracing representatives of every section of the community.

(3) Conference on the *farm* export development question.

(4) Government action (consequent on the laying down of a well-prepared plan of attack) designed to stimulate and encourage greater farm export surpluses of the type required.

Farming is a business — targets, budgets and the revision of budgets are essential to enable the farm to be run as a business. Farm management accounting, and the availability through the Department of Agriculture of district

standards of production and the cost of production, are of inestimable aid to those who avail themselves of this knowledge. The assistance of research and the extension worker is available to all who seek it. A much greater drive to expand markets is essential and the cost must be faced.

This is a challenge to farmers themselves, and the whole nation depends on their effort.

DISCUSSION

Q:: *Does the speaker agree that the farming community should enjoy privileges that the rest of the community does not enjoy?*

A:: No. There are, however, disincentives in farming which should be removed. In some instances, manufacturers enjoy privileges denied to the farming community. However, even short-term advantages of one section of the community over another are undesirable.

Q:: *Is the Government's policy of one man, one farm diverting money away from farming?*

A:: I would not know whether it is diverting money from farming, but in its present form there is no doubt that it inhibits progress and may well react against the best interests of the nation. The pendulum seems to have swung too far in one direction, leaving the problem of the uneconomic unit.

Q:: *What would be the effect on the economy of the country if death duties were abolished?*

A:: No short answer to this question could be completely satisfactory. A great many people spend a great deal of time planning to minimize their death duties. This is possible, of course, where there is a big estate and arrangements can be made for a reasonable standard of living for the farmer disposing of his estate in his lifetime. However, the man with an estate worth, say, £20,000 to £40,000, finds this a difficult exercise and there is no doubt, in my opinion, that the effect of death duties as they operate at present retards progress and diverts money from development.

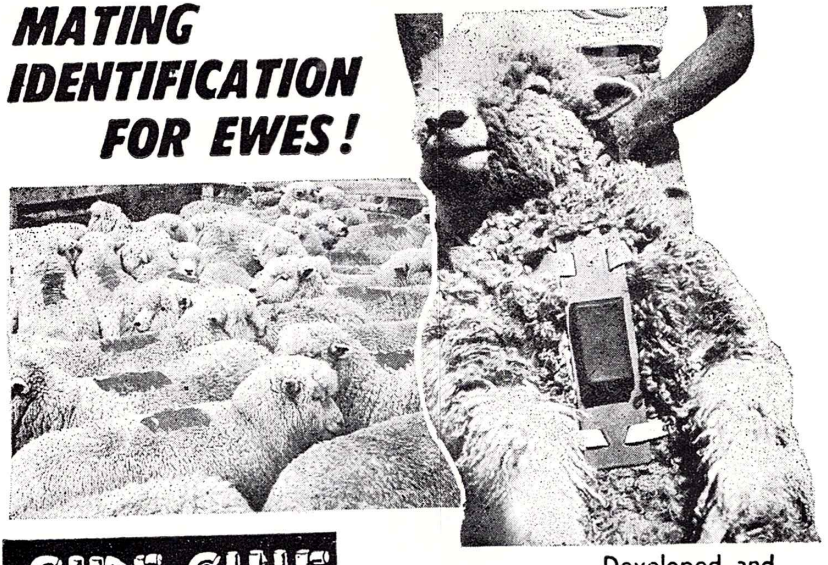
Q:: *Would not the Government get back an equivalent amount immediately in income tax?*

A:: There are two words in the question which make it difficult to answer: the "equivalent" amount yes, and probably more than an equivalent amount, but not "immediately". Any development project takes 3 to 5 years to come to fruition, and there is usually a lack of liquid cash in the early stages when further stock and/or plant have to be purchased. Under the present law, income tax could be as high, if not higher, and there is less cash with which to meet it, so that any incentive which was considered must have regard to this time lag if it is to act as an incentive.

Q:: *Does the general "farmer unawareness" of the serious situation not lead to farmer apathy?*

A:: Yes.

MATING IDENTIFICATION FOR EWES!



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   (c) to avoid the need to supervise them at lambing.
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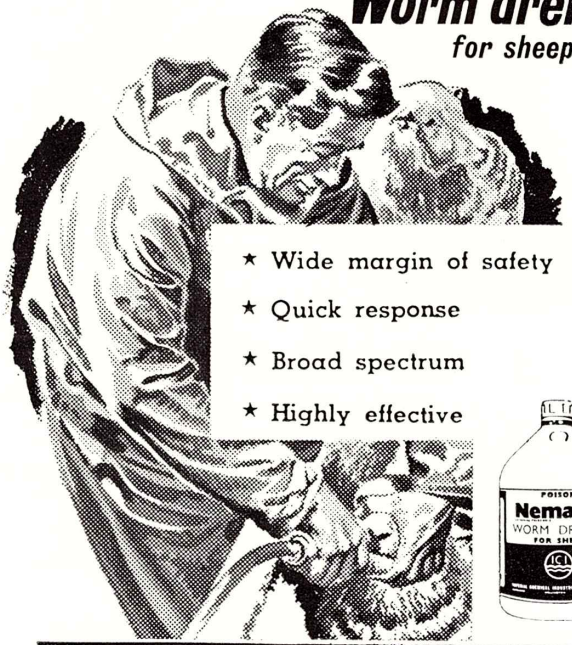

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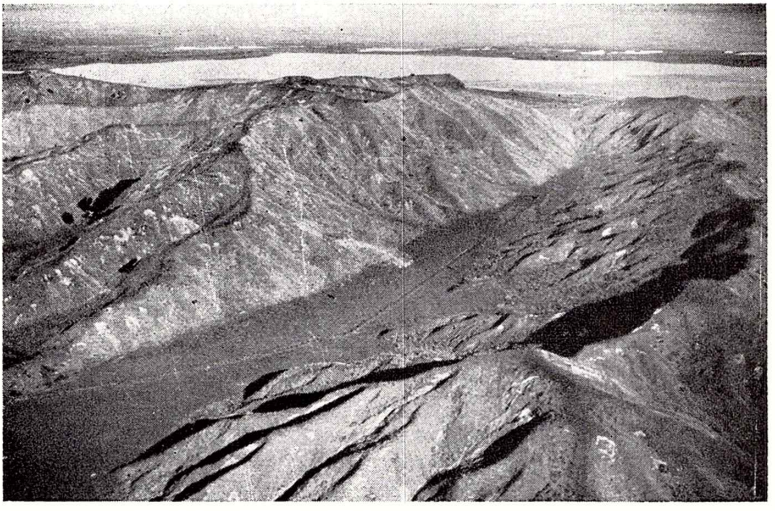

CHEMICAL METHODS OF HILL COUNTRY PASTURE IMPROVEMENT

G. S. ROBINSON*

IN THE LAST ten to fifteen years, hill country pastures have shown steady improvement in composition and yield. From the time that aerial topdressing made it possible to meet the phosphate needs of deficient soils and to establish clovers in what were cloverless pastures, the higher-producing species have tended to increase slowly in these pastures. On poorer pastures, the invasion of weeds, scrub and fern has been slowed up and in many cases halted. Nevertheless, the increases in carrying capacity envisaged by Sir Bruce Levy have not yet been realized. The possible reasons for this lag are:

(1) Many pastures still contain species which contribute little, if anything, to the needs of stock. Although the invasion of further inedible species like tauhinu may have been prevented, many pastures still contain the mature plants.

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(2) Clovers may have increased, but pasture production is still held up by lack of good grasses. These cannot be satisfactorily oversown on to established pastures on most hill country.

(3) There is an indication that fertilizer at the levels being used is not sufficient to give anything like the potential yield.

(4) There is no doubt that on many farms the increased growth resulting from aerial topdressing is not being used. Stock numbers are too low.

Some of these difficulties can be overcome quite readily if and when they are made known. This is especially so in respect of fertilizer application rates and the utilization of pastures. However, the improvement in grass content of hill country pastures is more difficult. The methods that suggest themselves are:

(1) Cultivation and the sowing of a pasture mixture. Results are generally good, but the method is limited to land of suitable topography for tractor work. It has the advantage that a crop can be taken off. But in many cases the better procedure would be to sow direct to pasture, especially where rainfall and fertility levels offer little chance of a payable crop yield.

(2) Heavy trampling with cattle can be used to precede the surface sowing in the spring of the severely broken turf. This method must be restricted to small areas, adequately fenced, in order to get satisfactory conditions. Some years of fertility building with clovers may be a prerequisite to successful establishment of the better grasses.

(3) Overdrilling as a method of pasture improvement is discussed elsewhere by M. W. Cross (p. 43).

(4) The use of chemicals to reduce or eliminate competition from resident species is the final possibility. This may take the form of complete killing of the old pasture or, as L. W. Blackmore of the Department of Agriculture has suggested, in some cases the poorer grasses may be reduced by a lighter chemical treatment.

The main purpose of this paper is to discuss a preliminary trial with chemicals carried out at the Massey University College hill farm at Te Uri in Central Hawke's Bay on some very poor hill country. This trial was established

following the good results obtained by Mr Blackmore on better class hill country at Pahiatua. The object was to see whether similar effects could be produced where the conditions both of soil and climate were likely to be much less suitable to the growth of good pastures. Experience at Massey has shown that the method has some promise. It has not been possible to repeat the sowings, so that the College has the experience of only one establishment year. It is too early to make firm recommendations, but it was felt that, even so, some airing of the problems associated with the method would be helpful in getting people to think about its possibilities and the discussion could perhaps be valuable in helping to decide what type of follow-up trials should be used.

The trial was laid down in March, 1960, on the College farm at Te Uri where the annual rainfall is about 55 in. The soil is a Mataikona silt loam which is derived from argillite.

A three-acre area was fenced off, most of it being too steep to cultivate. The plot took in both a northerly and a southerly face. The original vegetation consisted of scattered tauhinu, up to 3 ft high, with a very mixed pasture dominated by browntop, danthonia, sweet vernal and flatweeds. There were practically no clovers present.

The area was sprayed with 5 lb dalapon and 2 lb of weedazol in 20 gal of water per acre. A 6 ft spray boom carried by two operators was supplied from a centrally sited pumping unit by a long length of hose. At the time of spraying the pasture had recovered from the summer dry spell but was closely grazed. Mild cloudy weather prevailed following spraying, with periods of rain. On March 23 — 18 days after spraying — the seed and fertilizer were sown. By this time the original vegetation, apart from the tauhinu, had browned off. The seeds mixture was broadcast by hand at the rate of 20 lb/acre. It consisted of perennial ryegrass, cocksfoot, crested dogstail, subterranean, white and red clovers. It was based on experience gained from nearby plots established in earlier years following cultivation. The only fertilizer the trial area had received previously was 2 cwt/acre sown from the air in 1958. At the time of sowing the seed, 3½ cwt/acre of superphosphate was put on by hand. The soil surface was moist at the time of sowing and the germination conditions were improved by sixty points of rain which fell in the following week.

Establishment was notably slower than would be expected from a cultivated seed-bed. The northerly face looked much the better during the first winter and by July the young pasture was about two inches high. There was a good intermingling of grasses and clovers with insufficient density to cause smothering of either. Grazing was therefore held off with the object of allowing good root growth until early November when there was 6 to 9 in. of growth. The 3 acres then carried 45 sheep per acre for five days followed by 20 bullocks per acre for a day and a half. Although the southerly face had earlier made very slow progress, and looked like a possible failure, it developed well in the spring and was equally as good as the warmer face by the time the area was first grazed.

Intermittent grazing with sheep and cattle was used to keep the pasture in control during the first summer and autumn. Experience indicates that this system worked very well in allowing the sown species to become dominant and thus smother out any pockets of the original pasture that had persisted.

During the 1961 winter, just under 3 ewes per acre were carried on the area, these being set-stocked from early June, until December when the lambs were fat. Since then, the farm experienced the very dry 1961–62 summer. The pasture stood up to it very well. Growth practically ceased but the sown species survived and came away strongly with the autumn rain. Shortage of labour on the farm has prevented records being kept of the exact stocking since that time. Both sheep and cattle have been used, and the main objective has been to keep the pasture well controlled so that some indication of its persistency under good grazing conditions could be gauged.

At present — some three years after establishment — the composition in terms of the sown species is much better than that of the average hill country pasture in this district sown by conventional methods. A recent botanical analysis shows that there is over 35% of perennial ryegrass present. There is no ryegrass outside the plot area where the pasture has been oversown with 2 lb of white clover and had 4 cwt of superphosphate applied. There is 6% cocksfoot on the plot, none outside. There is 21% white clover on the plot, 1½% outside. Browntop on the plot is 5%, 29½% outside. Danthonia is down to 1% from 12% outside. Bare-ground remains fairly constant at about 10%. These figures indicate a pasture of good composition especially in view of

the comparatively light topdressing programme, namely, 3½ cwt of superphosphate at the time of sowing and only 2 cwt superphosphate per year since then.

Several aspects of the trial need further comment.

(1) Where the original pasture was poorest, the best establishment of clovers occurred and, despite the shallow soil and dry conditions, there has been very little reversion to browntop and danthonia.

(2) Tauhinu plants have not established in the new pasture. Old plants have shown benefit from the treatment and are bigger and stronger than those outside the plot area. This could be due partly to the fertilizer applied and partly to the nitrogen supplied by the strong clover growth. Whether these plants will gradually die back as they age, or whether some other treatment will be necessary to control them, is a matter that needs resolving.

(3) The trial being discussed is only a preliminary one. The next stage in the investigation is to examine the use of aircraft for spraying and sowing, and Mr Blackmore has had some experience of this. It had been hoped to look into this matter further at Te Uri, with Mr Blackmore's help, but this has not been possible as yet. Two aspects need sorting out. It is necessary to know how efficiently an aircraft can spray on steep broken country, and also what the cost of the aerial operations are likely to be. Present-day costs appear to be in the region of £14 to £15 per acre including spray material, application, a good seeds mixture, and 4 cwt of superphosphate in the first year. Some reduction in the cost of spray material could perhaps be expected in coming years. A comparison also needs to be made of chemical preparation on the one hand with the expenditure of the same money per acre on heavier seeding and fertilizer applications on the other.

(4) Dalapon and amitrol were used in this trial. Since then paraquat has come on to the market and has a big advantage in that there is no residual effect in the soil. Consequently, spraying and seed and fertilizer sowing can be done on the same day.

(5) Seasonal weather conditions could play an important part in the success or otherwise of this method. The fact that the seed has to establish on the surface of

the ground would indicate that there are possibly greater risks involved than where the seed can be covered. A widespread series of trials covering different districts and in different years is necessary before a complete assessment of the method can therefore be made.

Many other aspects of chemical preparation of seed-beds for pasture need to be investigated. In the meantime, the method appears promising as a rapid means of pasture improvement on hill country too steep to be cultivated.

Acknowledgement is made to L. Fowler, Manager of the Massey University College farm at Te Uri, for his co-operation in the grazing management during the trial period.

DISCUSSION

Q:: *What were the seeding rates of white and red clover in the mixture? Was the persistence of red clover satisfactory?*

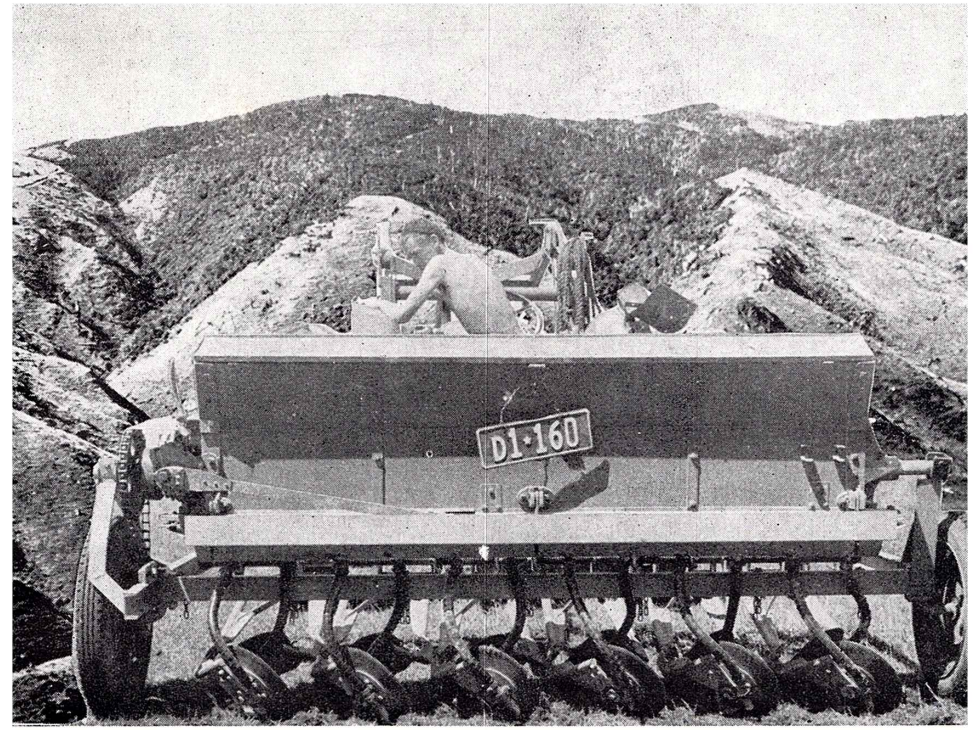
A:: Two pounds of each of white and red clovers were sown. Red clover did not persist as well as we had expected. Plots established in previous years on cultivated ground had indicated that red clover would be a valuable pasture constituent for some time. On this occasion the set stocking in the winter and spring of the second year may have been too severe for it.

Q:: *Are trees, especially native broad-leaved ones, affected if a total kill of the pasture is attempted by spraying from an aeroplane?*

A:: We have had no experience of this.

Q:: *Is this type of pasture improvement possible on country infested with rushes?*

A:: The use of dalapon at the rate suggested would not be satisfactory in controlling the rushes. This type of country would need to be prepared some years ahead by heavy cattle grazing, but the effectiveness of this would be dependent on the species of rush present.



HILL COUNTRY PASTURE IMPROVEMENT BY OVERDRILLING

M. W. CROSS*

ALTHOUGH many of the hill country farms of Central and Southern Hawke's Bay may be described as being "very much up on end", closer inspection reveals that often as much as half is negotiable to wheel or crawler tractors. Much of it, however, is covered with fallen timber stumps and stump-holes, rock in many places is covered with a very thin layer of soil, wind and water erosion can be a menace, and wide variations of temperature and rainfall are experienced throughout the year. The soil in this area is derived from argillite, dries out readily in the summer, and gully erosion is a major problem.

With this information to hand, any development or improvement programme must be approached cautiously if costly errors are to be avoided. As development work is expensive, the choice of methods is likely to be very much influenced by available capital, and by the probable delay before increased returns become a reality. Each method

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of developing this class of country must therefore be considered on its merits and critical comparisons made between the alternatives offering.

These considerations were sufficient inducement to include overdrilling in the trials on the College property at Te Uri, Central Hawke's Bay, where investigations have been made of likely development methods during the past nine years. The present trial confirms that overdrilling has distinct possibilities.

Overdrilling Trial

A block of 3 acres of rather easier country suitable for wheel tractor operation was selected adjacent to the chemical trial described by G. S. Robinson, most of which was on ground too steep for cultivation. A 5 ft Connor-Shea tractor-mounted disc drill was used in a once-over operation, sowing in 6 in. rows serpentine-superphosphate at 3 cwt/acre and the same seeds mixture and rate as used on the chemical trial. (Perennial ryegrass, cocksfoot, crested dogstail, red, white and subterranean clovers at 20 lb/acre.) Trailed chains helped to cover the seed.

It is emphasized that overdrilling must be done correctly. The more difficult the area, the greater the need for precision. It is not just a matter of driving over the hills with a disc drill and hoping for the best. Operating over steep country and irregular surfaces requires a performance higher than that of conventional drills. As no really satisfactory overdrilling machine is available, modifications are necessary to current drills.

The 5 ft mounted drill was selected as it would follow the uneven surface better because of its narrow width and in-line coulters, giving less strain on the drill when crossing humps and better sowing in the hollows. The mounted machine was much more manoeuvrable than a trailed one. As it ran on its own wheels when sowing, the front end of the tractor was not affected when steep pinches were negotiated. Baffles were required in the seed and fertilizer boxes because of the steep side slopes encountered. The disc angle was increased to make a more positive groove about 1½ in. wide through the existing turf. As the discs ran on ball bearings, these accommodated the extra side thrust. Deflectors were fitted inside the seed boots to direct the seed and fertilizer into the bottom of the ¾ in. deep groove no matter what the degree of side slope. The benefit of these changes, especially on the uphill half of the drill, was clearly demonstrated when clover and grass plants established in an almost unbroken line along *all* rows. The

ground was too rough for harrows to be of any use for covering the seed so trailing chains were attached to each coulter and their added weight also assisted each disc in penetrating the sometimes tight surface mat.

At the time of sowing (March 23, 1960) the pasture had recovered from a summer dry spell and had been closely grazed. In the four days before sowing, over an inch of rain fell and this was followed by a further 60 points in the week after sowing. Moisture conditions were therefore excellent, both for penetration of the disc coulters and germination of the seed.

A good strike resulted and the establishment was much quicker than on the chemical trial, no doubt owing to the placement of the seed in the soil. Subsequent growth of the clover was obviously stimulated by the placement of the superphosphate in the drill row instead of being broadcast. The grasses established satisfactorily but showed evidence of nitrogen deficiency and made little further growth during the next six months. The area was grazed in July and again in November when a further 2 cwt of superphosphate was broadcast over both trials.

From then on the chemical and overdrilled areas were grazed as and when growth dictated. By the end of January there was an almost complete cover of clover—so markedly different from the patchiness associated with the establishment following aerial sowings. The sown grasses were making a little growth and the browntop had been stimulated by the clover. Both the chemical and overdrilled areas (each of 3 acres) were set-stocked with 8 wethers each from March to June, 1961, together with 3 bullocks for the first two months and 7 bullocks for the last month. They were then set-stocked with 8 ewes each and these remained till December when the lambs were fat.

Both areas came through the very dry 1961–62 summer in good condition and subsequently the objective in grazing has been to keep the pasture well controlled, using both sheep and cattle. The present condition of both pastures (3¼ years after sowing) appears to differ little from the botanical analysis made last winter (Table 1).

The results of this analysis are in line with expectations as a result of the treatments — the sown species dominant in the chemical area with some bare ground and weeds in evidence; the resident grasses still persisting in the overdrilled area but at a reduced level; very few introduced species in the control area although this had been sown aerially with clover and superphosphate a year prior to laying down the trials.

TABLE 1: Botanical Analysis, July, 1962

Species	Percentage Area Covered		
	Chemically Treated	Overdrilled	Control
Perennial ryegrass	35.5	13	0
Cocksfoot	6	3	0
White clover	21	18	1.5
Subterranean clover	1	4.5	0.5
Browntop	5	29.5	30
Crested dogstail	1	6	2
Danthonia	1	7.5	12
Other species	19.5	13.5	42*
Bare ground	10	5	12

* Including 21.5% annual clovers.

Discussion and Conclusions

This trial demonstrates that overdrilling has definite possibilities as a means of improving this type of hill country. How and where it can be used to best advantage are problems which can be decided only by taking all relevant circumstances into account for each situation. It offers sufficient attractive features to warrant its inclusion in any proposed development programme. It is again pointed out that, once both areas were established, they were stocked at the same rate and grazed similarly. The overdrilled area has since maintained production equally as well as the chemical treated area, yet the cost of establishing it was less than half that for the chemical treatment.

INITIAL COST OF EQUIPMENT IS LOW

A suitably equipped wheel tractor, a drill, and trailing chains for seed covering are all that are required for sowing. The tractor should have extension steel grippers fitted which increase the overall width of the wheels appreciably, to improve lateral stability. The lugs should penetrate *at least* 3 in. to provide traction and prevent side slip. The increased soil fertility has also encouraged the growth of tauhinu. No new plants are apparent but the existing bushes have increased in size considerably and now require attention. A tractor-mounted rotary slasher could travel over the same country as was drilled and should prove adequate. Some effort should be made to clear fallen timber but stumps can remain. The same wheel tractor can do this clearing. Thus the total cost of the equipment would be around £1,500, appreciably less than that needed for a crawler tractor and a range of cultivating and seeding equipment.

The overdrilling could be done by contract if suitable plant were available, but this is seldom so. Correct timing of the operation is essential, thus it is much more desirable

to have the machinery on the spot so that full advantage may be taken of favourable conditions.

QUICK IMPROVEMENT GIVES EARLY RETURNS

The rapidity and uniformity of clover establishment over the whole of the overdrilled area was impressive in this trial — undoubtedly it was aided by the concentration of fertilizer along the drill rows. Periodic grazing during winter and spring are necessary to control resident species and by October/November the area could be grazed normally.

NO EROSION MENACE

At no stage is the area more susceptible to erosion as a result of the treatment. As the ground is not broken or loosened as with cultivation, the tractor will have no difficulty in negotiating sidlings and will not be moving soil downhill as it does so. In comparison, cultivation exposes the land to wind and water erosion both during the preparation of the seed-bed and up to a year after sowing.

On the debit side, the contour of the country is unchanged and stump-holes and other irregularities remain to plague the shepherd. Scrub is unaffected — indeed, growth of the established plants is encouraged and other measures are necessary for its control. The technique is new and modifications to current drills are needed to obtain best results, as no specific drills are available. An experienced wheel-tractor driver who has the interests of the operation at heart is essential — he may be hard to find; more so than an experienced man for hill country cultivation. Finally, it must be emphasized that grazing management should be adjusted to allow the young grass and clover seedlings an adequate growth period before defoliation and at the same time prevent smothering by the resident species. This is not as straightforward as caring for a newly-sown pasture.

Vigorous growth of the pasture cannot be achieved without correct and continued fertilizer application which should be in line with responses obtained in that locality.

Because overdrilling is a short-cut method of pasture improvement, the work must be done as precisely as possible and the area grazed to the maximum advantage of the introduced species. It is far better to do a relatively small area well, than a large area haphazardly.

In this connection the writer wishes to express his appreciation to L. Fowler, who was responsible for the stocking arrangements. His sound judgement in respect to frequency and severity of grazing undoubtedly contributed very appreciably to the success of these trials.

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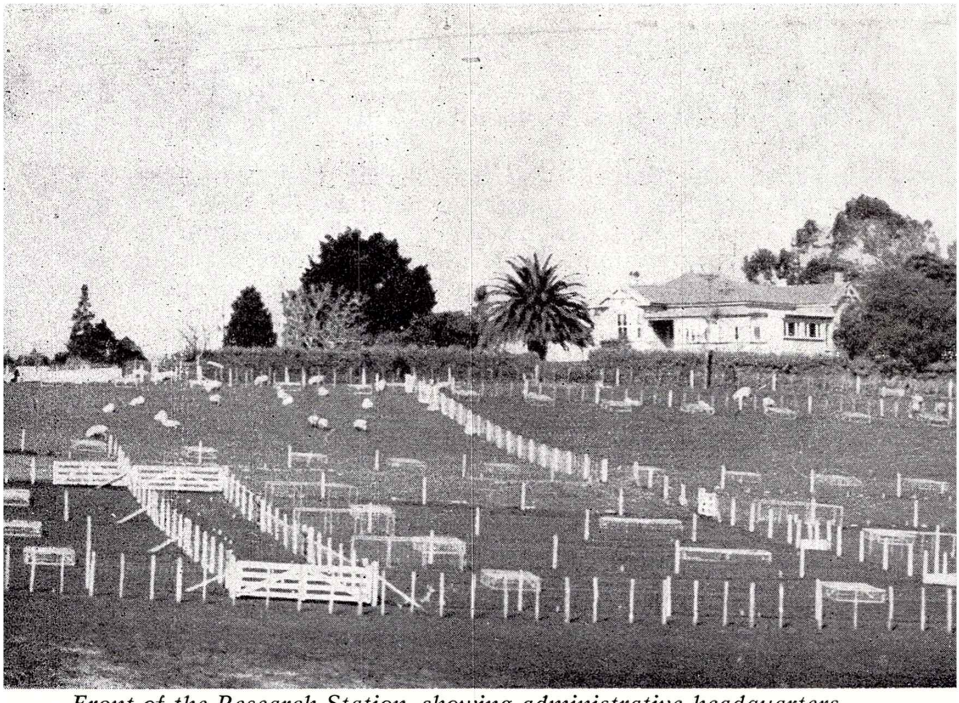

Front of the Research Station, showing administrative headquarters in background, and in the foreground a trial comparing differing techniques of measuring pasture growth.

THE WORK OF THE RUKUHIA SOIL RESEARCH STATION

I. L. ELLIOTT*

THE RUKUHIA SOIL RESEARCH STATION was first established in 1945 as part of the then Extension Division of the Department of Agriculture. An area of some 60 acres 3 miles south from Hamilton on the main road to Te Awamutu was selected as the site for the field and administrative centre, and those who have visited the Station will attest to the magnificence of the situation. It is unfortunate, however, that although the situation is truly wonderful it can hardly be said that the area was chosen purely because of its value for research, and its limitations in this respect quickly became obvious. Since the time of its establishment, additional areas have had to be acquired to make possible the carrying out of the Station's functions. At present the Station administers an area of some 370 acres, with the prospect of acquiring a further 300 acres of raw peat, part of which will be kept in the undeveloped state as a reserve for the future.

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When the Station was first established, the chemistry section of the Department was transferred there and the new organization was headed by R. E. R. Grimmett, the first Superintendent. The fundamental aim in setting up the organization was to provide facilities to the Farm Advisory Division by way of services and research, and this still remains its objective, but perhaps in recent times with rather more emphasis on the research side of its activities.

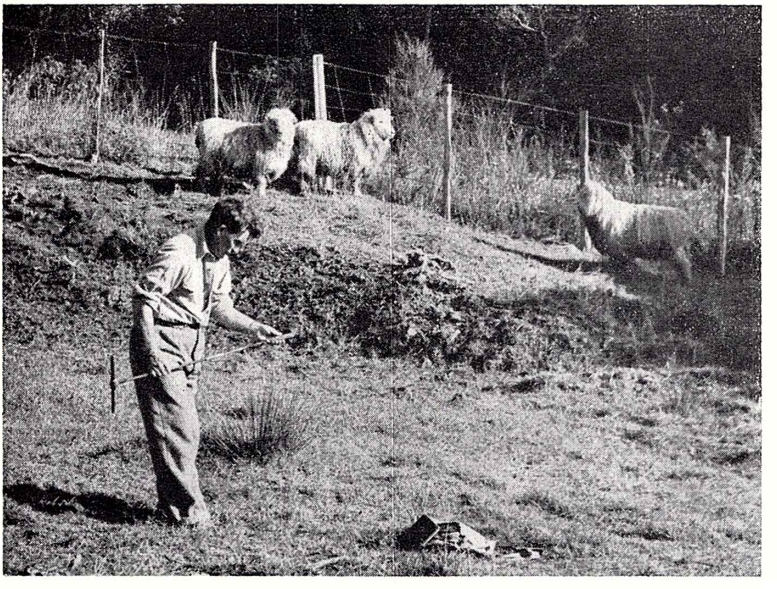
The Station's real sphere of interest in research is the field of soil fertility. In other words, it is set up to conduct research into those factors which limit the productivity of soils in New Zealand. Such factors might be plant nutrients — whether they be major or trace elements; they might be lack of water or too much water; they might be conditions which inhibit the growth of certain types of micro-organisms; or they might be many other factors or a combination of them.

Soil Testing Service

In describing some of the work in more detail, mention might first be made of the soil testing service, what it comprises, why it is limited in the way it is, and how it might be more extensively used by farmers in framing a somewhat more realistic approach to their soil fertility problems.

As it is designed at the present time, soil analyses are conducted to give information about the needs of soils for lime, phosphate and potash. The Station does not at the moment analyse soils to give advice on their requirements for trace elements, although analyses for magnesium will be carried out if desired. The reasons why analyses for trace elements on advisory soil samples are not performed will not be discussed, other than to say that it is felt sufficient background evidence of the occurrence of these trace element deficiencies has not been correlated with a suitable test to make advisable the use of such a test. At present this is an aspect of the work which has received a great deal of attention and there is promise that methods will be developed of sufficient accuracy to warrant their being used in the future.

Although some 20,000 soil analyses are carried out each year, the soil testing service is probably not playing the part in improving advice on fertilizer programmes that it could do. Too often it is merely being used in a hit-and-miss fashion to give information about a particular problem on



Farm paddock to paddock sampling of soils tends to pinpoint and focus attention on some aspects of farm management.

a particular paddock. Soil tests should be obtained on each paddock of at least the more developed farms, to build up a picture of *relative* soil fertility of the varying paddocks making up a farm. Only in this way is it possible to develop a rational whole farm approach to topdressing. In this connection it is possible that one of the strongest aspects of the soil testing service is the biggest barrier to its wider use. Samples are taken by advisory officers thoroughly trained in sampling techniques and fully qualified to give sound advice to the farming community. It is one of the main points that the advice that farmers get comes from the advisory officer and not directly from the laboratory. It could, however, be one of the weakest links in the chain if, through pressure of other work or through disinclination to use the service, advisory officers actively discourage farmers to use the service to the fullest extent.

One of the further advantages of farm paddock to paddock sampling is that it tends to pinpoint and focus attention on some aspects of farm management. It can, for instance, reveal quite clearly to the farmer the means by which fertility can be transferred round the farm.

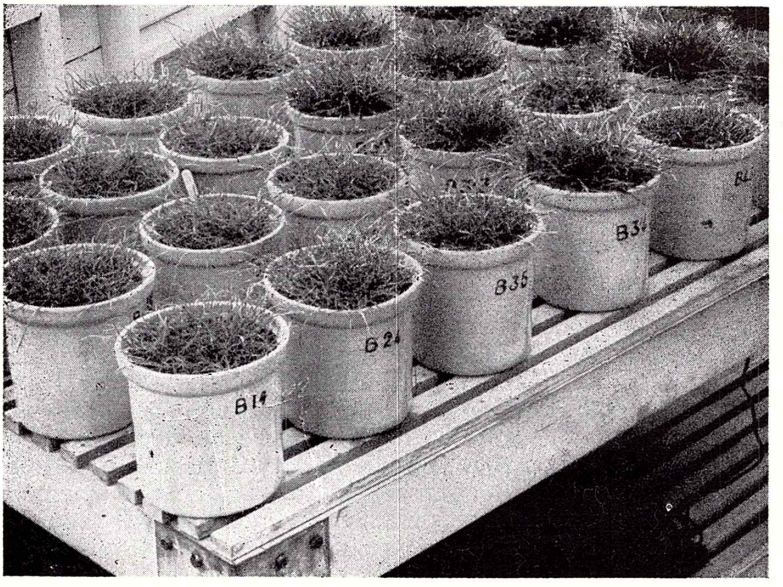
Optimum Fertilizer Use

A second important activity of the Station is closely related to soil testing. It concerns the efforts being made to relate pasture productivity and soil test level to rate of fertilizer application. In other words, for many years now, there has been active concern with the problems of:

(1) The rate of fertilizer needed for maintenance of maximum economic pasture yield.
(2) The effect of using (a) more than maintenance; (b) less than maintenance.
(3) The relationship of these to soil test and pasture productivity.

For many years, New Zealand's annual fertilizer bill has been increasing. Today it stands at £14 or £15 million annually, and shows every promise of continuing to expand in the future. In fact, it will be a poor look-out for New Zealand agriculture if it does not continue to grow. Add to this the cost of applying half this material by air, and a very formidable bill indeed is reached. None of this, of course, is too serious if it results in greater farm and national productivity from grasslands, but it does demand a national consciousness of the problem of whether or not the money is being spent in the most efficient way possible. The question of optimum fertilizer rates is one of the most important being faced today, and the Station is playing its part in seeking the answer.

Much time has been spent in trying to work out a method of attack. This is not quite as easy as it appears at first glance, but techniques have been developed and what is now required is that trials employing them, and designed to cover all major soil types, should be established as widely as possible over New Zealand with the least possible delay. This information has already been obtained at Rukuhia for some of the major Waikato soil types, and trials have been spread still further afield to cover soils in the Matamata, Tokoroa, and Otorohanga districts — but this represents only a small part of New Zealand. The matter is, however, receiving the attention of the Department of Agriculture. Other trials of a similar nature have been or are about to be established at Marton, Taranaki, and in the South Island. The importance of giving this work high priority cannot be emphasized too strongly. Although there may be many instances where farmers will not be able to apply optimum rates of fertilizers, it is important to know what these rates should be.



Pot trials are one of the techniques used to study the effects on growth of plant nutrients.

Plant Analysis

A different, but by no means less important, side of Rukuhia activities is plant analysis. In order to find out what nutrients a plant lacks, it would, one would think, be a relatively simple matter to analyse plant tissue and find out. Unfortunately, it is far from such an uncomplicated matter, and a large number of variables have to be allowed for. First, plants vary in their ability to extract nutrients from the soil and in their basic nutrient requirements, and consequently what may hold for one species is not necessarily true of another. Secondly, plant tissues vary with age and maturity, and as a result, sampling is difficult. Thirdly, plants can vary in their seasonal uptake, and this may be an important factor. Fourthly, any nutrient deficiency must be considered in relationship to other nutrients. For example, a certain sulphur level may be permissible at low nitrogen levels, but may be quite unacceptable at high levels of nitrogen. So, altogether, it is a pretty complicated business.

Perhaps the most difficult aspect of this type of work, however, is to accumulate information which can be used

as criteria of deficiency, particularly when the plants concerned are pasture plants.

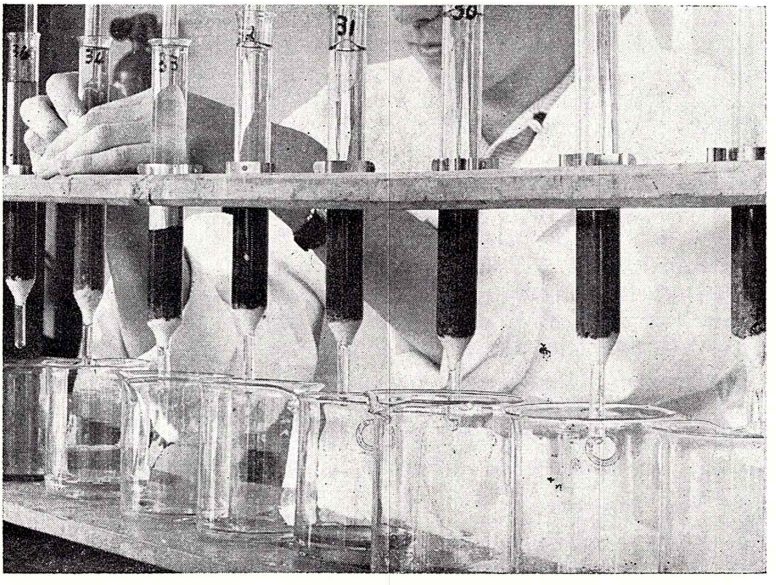
The very formidable task which faced K. J. McNaught at the laboratories was to build up the vast body of information which he possesses today and which can now be used in the prediction of deficiencies. He has been on this job ever since the establishment of the Station in 1945, but the critical factor which has made this work possible has been the development of the spectrographic section under J. E. Allan, which has made total ash analyses possible. Between 1952 and 1962, some 30,000 samples of plant materials have been analysed for a wide range of materials. The analysis of these samples has given information on the levels of nutrient occurring in plant tissues in nearly a quarter of a million instances. With all this information as a background, the stage is now being reached where it is possible to obtain a very valuable guide to the likelihood of nutrient deficiencies occurring in the field. As time goes on and even more data accumulate, the method will become more and more valuable.

Deficiency Studies

It will readily be appreciated that, if plant analysis on its own can provide a useful diagnostic guide to deficiency, and if this is combined with soil analytical data and responses gained from pot trials carried out in glasshouses at the Station, and all three methods of approach indicate the same deficiency, there is a very strong likelihood of being able to predict the occurrence of these deficiencies in the field.

This kind of approach, not possible in the past through lack of background information, should, if fully employed in the future, do a great deal to help in unravelling the tangled skein of nutrient deficiency in New Zealand soils. There is probably no other institution, inside or outside New Zealand, so well equipped to carry out this research on the requirements of pasture plants.

Perhaps an example of the type of work now possible will help give an appreciation of the value of the approach. For a long time it has been known, as a result of trials conducted by the field officers of the Farm Advisory Division and by Rukuhia, that certain pumice soils of the central North Island are sulphur deficient. There has, however, been a tendency to suggest that there is no need to



The rate at which nutrients are leached from the soil can be measured by passing water through cylinders of soil samples.

worry about additional sulphur because in applying 3 cwt of superphosphate, which is a fairly normal topdressing for these areas, an adequate amount of sulphur would be applied. There is, however, one factor which until recently was overlooked — the rate at which sulphur may be leached or drained out of the soil.

To study this aspect of soils in the laboratory, D. E. Hogg packed soils into cylinders after they had been mixed with, say, superphosphate, applied water to the top of the soil column and collected the material which drained through the bottom. The amount of water applied is designed to reproduce a fairly normal but nevertheless heavy downpour of rain. The water collected at the foot of the column is then analysed for phosphate or sulphur or whatever material is being studied.

It may be argued that this method is highly artificial and can bear no relation to what is likely to happen in the field, because there are no plants with roots capable of taking nutrients up to the soil surface and there are no stock grazing the plants, with their consequent heavy depositions of dung and urine. This is, of course, quite

true, but the point really is that, if a series of soils are treated in exactly the same way and large differences appear in their behaviour under this leaching technique, then it is at least a fair assumption that they will behave differently in the field. This is precisely what happened in the case of two soils, for instance, when their capacity to hold sulphur against leaching was examined. One of them lost only 2% of applied sulphur after four weekly leachings, whereas the other lost 20% in the first week, 30% in the second week, 20% in the third week, and 12% in the fourth week. So the picture emerges of one soil losing 82% of its added sulphur after four weeks, and the other losing only 2% after identical treatment.

At present a survey is being conducted of some dozen pumice soils to try to obtain more information about the place that sulphur plays as a plant nutrient. To do this, various aspects of the problem are being investigated by:

(1) Soil analysis.
(2) Plant analysis.
(3) The leaching technique briefly described above.
(4) Microbiological methods to determine the presence or absence of sulphur bacteria.
(5) Pot trials.

Depending upon results obtained, these will be followed up by field trials to confirm their practical importance to farmers.

This type of work has been described in some detail because it does demonstrate quite clearly the kind of approach which can be developed on a whole range of plant nutrient problems.

The foregoing has been sufficient to give only a general idea of the type of activity the Station is currently engaged in, and represents at best only a small cross-section of the work. It is obviously impossible to refer to all the activities of the Station, but there are a few other sections which may be of interest. For instance, one section is devoted to the chemical control of weeds in crops and pastures. Much of its work is designed to give information about the relative tolerance of crop and pasture species to the many different herbicides at present on the market or likely to become available in the future. Another section has devoted its time specifically to the development of peat soils and the numerous particular problems which they

present. There is a section on tropical agriculture, one on microbiology and one on soil physics. In addition to all this, a good deal of service work is carried out on lime, fertilizer, soil and plant analyses.

Thus, though the Station is located in the Waikato, the work done is not confined to local problems. It covers many problems in both islands, and services of the Station stand behind the advisory officers of New Zealand wherever they may be. The work being done is immensely stimulating and full of promise for the future, and as time goes by it is hoped that Rukuhia will be able to play an increasingly prominent part in New Zealand's agriculture.

DISCUSSION

Q:: *In what types of soil would you expect fixation of phosphate to be a problem?*

A:: The question is a very difficult one to answer briefly, but, in general terms, soils do vary in the amount of phosphate they fix, and soils which are coarse in structure and sandy in nature tend to be less fixing than soils which are high in the finely-divided clay fraction or in which organic matter tends to accumulate.

One of the interesting aspects of the work recently carried out at Rukuhia has been that done by Karlovsky in which he draws attention to the fact that, if fixation is considered in relation to the amount of phosphate being circulated through the plant and animal, then the amount of fixation occurring is much less than one would assume from the standard type of short-term phosphate recovery trial in which it has been argued that of all the phosphate we apply only about 20% is recovered. Karlovsky's figures suggest a utilization of the order of 75%.

Q: *Are birds effective in the control of grass-grub in pasture?*

A:: I think there can be no doubt that birds do have a very considerable effect in controlling grass-grub in pasture. Unfortunately, however, their control has never been effective enough to prevent considerable pasture damage. Certain types of birds are apparently much more effective than others, and at present, if I understand it correctly, a survey is being made of the bird population in certain districts and its effect on insect control.

Q:: *Can information obtained from soil tests determine the maintenance requirements of fertilizer for pasture carrying 4 sheep per acre as against 8 sheep per acre?*

A:: Before this question can be discussed there are several points needing elaboration. For instance, one would require to know whether the reason for the sheep being carried at the higher rate as against the lower rate was purely through the natural level of soil fertility. If this were the case, then soil tests would almost certainly reveal a difference in fertility status between the two areas. On the other hand, it may well be that the fertility in the two areas could be the same, and one farmer could be carrying twice as many stock as the other purely through much more efficient

grazing techniques, in which case there would be no difference between the two areas and soil tests would not distinguish them. At present, insufficient maintenance trial work has been done to clarify the situation in all locations. There is, however, one point I would like to make which has a bearing on the question, and that is that, where larger numbers of stock are being run, the main cause of losses from the cycling system of phosphate through the plant and animal is through removals either in the animal carcass, or in animal products, or through depositions of dung and urine in ineffective parts of the grazing area. Then higher stocking rates will obviously result in higher losses from the system. It is therefore important to keep this in the background of one's mind when considering rates of fertilizer applied for maintenance. The specific answer to your question is really: No, soil tests on their own cannot determine maintenance requirements of fertilizer for pastures carrying differential rates of stocking.

Q:: *What is your opinion of the Truog scale?*

A:: In soil testing work there are many different extractants which are used by soil chemists to assess the amount of soil nutrients available to the plant. Before the Department's soil testing service was put into operation a wide range of these extractants was tried out in pot tests and the results from these trials were calibrated against known field responses. The Truog extractant was decided upon as being that which gave most reliable results under New Zealand conditions. I am not suggesting that it gave by any means perfect results, but it did give results which were more generally applicable than those obtained with any other extractant. This therefore was the extractant selected, and a scale by which its effect can be judged has been used in the Department's soil testing service. As I have said, in most cases it works satisfactorily.

Q:: *Are twice-yearly applications of phosphate and potash more effective in increasing pasture growth than a once-yearly application? If so, does this advantage result from an increase in total pasture production or from a prolongation of the season of growth?*

A:: The indications from most of our work at Rukuhia support the idea that a single autumn application of both phosphate and potash is the most effective in increasing pasture growth. This may, however, require modification in situations where losses of phosphate appear to be high, such as in some of the central North Island pumice soils. It may also be true that a different situation could arise where different climatic conditions exist. With regard to the second part of the question, the time of application of fertilizer has a direct bearing on the time at which the response from applied fertilizer is obtained. There does not appear to be a great deal of difference in total return from applied fertilizer when judged on an annual basis, but spring applications tend to affect late spring and summer responses, whereas autumn applications have a greater effect on winter production.

Q:: *Are farmers groping in the dark as regards fertilizer requirements unless all paddocks on the farm are soil tested?*

A:: I feel that the answer to this question depends very largely on the intensity of management adopted on any particular property. On an intensively run dairy farm or fat lamb farm, I think a good case can be made for the regular testing of each paddock on the

farm to obtain background information on the general topdressing policy of the farm. However, where the farm concerned is one where topdressing is being applied at minimal rates, factors other than soil testing perhaps have a greater implication on topdressing policy, and the soil test in these cases can perhaps be useful when applied on a more hit-and-miss basis. I would not think, however, that it is fair to say that farmers are groping in the dark under these conditions, because the Department of Agriculture has had established for many years a large number of field trials, and the results from these, when used in conjunction with the maps produced by the soil survey and soil tests, will give a reliable guide to the type of fertilizer required. The farmer's own experience and that of his advisers will fairly adequately determine the rate of application which should be recommended.

Q:: *Are there any special disadvantages in applying fertilizer in November or December because of availability of contractors, etc., rather than in the autumn months?*

A:: No; I do not think there are any real disadvantages in applying fertilizer at this time, provided one is concerned only with the annual increase in herbage. If, however, it is desirable to obtain additional winter feed, then it would definitely be preferable to make the application in the autumn.

Q:: *Has there been any work on copper nutrition of the plant in relation to responses on certain areas of the Taihape district?*

A:: As far as I know, no work on the copper nutrition of pasture plants has been done in the Taihape district. Much work has, however, been done in other areas of New Zealand, and notable responses to copper have been obtained on peats and on coastal sands in some parts of the pumice soils.

Q:: *Is there any information available as to the relative rates of leaching from the soil of superphosphate or serpentine superphosphate?*

A:: In general terms, the amount of phosphate lost by leaching from soils is considered to be very small. Of recent times, however, work done by Mr Hogg at Rukuhia, in which he has leached cores of soil to which different kinds of phosphate have been applied, suggests that, in certain soils at least, notably the more sandy pumice soils and some of the North Auckland soils, losses from leaching can be a very important factor. At this stage, however, this work is of a preliminary nature only and will require confirmation in the field. It is, however, quite noticeable that, when phosphate in different forms is applied to these soils, the losses of phosphate vary considerably with the type of phosphate applied. There is some suggestion in these instances that the phosphate in serpentine superphosphate is less rapidly leached than the phosphate in superphosphate.

Q:: *Do applications of dolomite and calcined magnesite increase the plant uptake of magnesium? Are these better than serpentine?*

A:: The answer to the first part of the question is: Yes, applications of magnesium-bearing minerals can and do increase the uptake of magnesium in plants. Work on the effectiveness of the different types of magnesium-bearing material are at present under way and final results are not yet available, but in some instances it

appears that dolomite is more effective than serpentine in raising the magnesium status of the plant when applied on the basis of their relative contents of total magnesium. Further information on this point will have to await trials carried out on a wider range of soil types.

Q:: *What is your opinion of "shot-gun" fertilizer mixtures?*

A:: Presumably by the term "shot-gun" mixtures is meant a mixture containing a whole range of trace elements. Personally I do not favour the use of this approach to remedy our plant nutrition problems as I believe it is much more efficient to apply the specific minerals required in those cases where it is clearly known that these should be applied. In other instances where it is not known whether they should be applied or not, I believe it would be reasonable to call on the services of the Advisory Officers in the district to have the matter investigated with a view to determining whether any specific trace elements are in fact in short supply, and if such investigation shows the use of specific elements to be necessary, then these should be applied. For the most part the use of "shot-gun" mixtures is expensive and in certain cases can be definitely harmful. The case springs to mind, for instance, of the situation in which a certain farmer was recommended to apply molybdenum against the advice of his Farm Advisory Officer and where molybdenum was already known to be high. As a result of ignoring the advice given him, the farmer was involved in considerable financial loss through applying a molybdenum-bearing "shot-gun" mixture.

Q:: *Does the earthworm affect the fertility of soil?*

A:: Yes, I think it can quite definitely be stated that the earthworm does beneficially affect soil fertility. There is, however, the reverse situation which tends to arise, namely that earthworms tend to follow soil fertility as well as create it, so that in situations where soil fertility is high and plant growth high one would normally expect a much higher earthworm population, and this in fact is the usual situation. Mr Nielson, an officer of the Rukuhia Soil Research Station, who has been interested for many years in the activities of earthworms, has isolated a hormone or growth substance which is capable of exerting considerable influence on plant growth. This appears to be in addition to the normal functions of earthworms in aeration and decomposition of organic matter.

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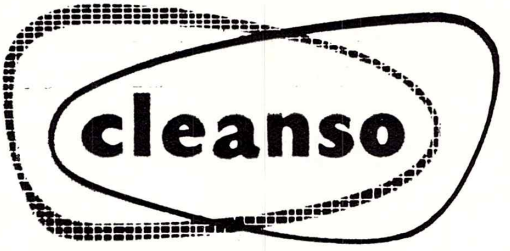

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ADVICE ON BUYING AND SELLING OF LIVESTOCK

J. T. McCAW*

Introduction

THE CENTRAL THEME of this paper will be the proper presentation of farmers' merchandise when selling and the careful scrutiny and appraisal when buying.

Put simply, the first thing in selling an article is to present it in its best form so that it will attract the potential buyer. With livestock, it should be graded (or drafted) correctly, prepared as well as possible, and put before the buyer in the best surroundings and in the best possible condition.

When one enters a shop to buy apples or nails or socks, the vendor presents them graded as to size, shape, colour, or quality. Who wants to buy a box of mixed nails, fruit or socks unless at a bargain price? The same principle applies to livestock. Who wants to buy a pen of mixed steers, heifers and bulls of half-a-dozen different breeds? No one except a dealer and he wants them cheap. This may seem elementary, yet the majority of farmers have not the foggiest idea of the elementary rules of salesmanship. Too

* *Wright, Stephenson & Co. Ltd., Palmerston North.*

often cattle are yarded for inspection in pens up to the bellies in mud, or sheep are kept in half-acre pig-pens where the buyer has to wade through the mud and peer round bunches of nigger heads and rushes to get a look at the article for sale. Again, it is not uncommon to arrive at a farm where all types of sheep or cattle are yarded higgledy-piggledy and it is left to the agent and buyer to sort out what is for sale. In this situation the sale is usually killed because all the better stock is capital stock and not for sale — whilst the poorer stock is for sale. Consequently, the buyer is in a position to compare it with the best on the farm and discounts it accordingly. Some vendors have theories, too, about the way to influence a buyer — or in some cases to hoodwink him — such as having a few obvious duds in the mob to make the rest look good or, on the other hand, to put in a poor beast hoping he will "hide up" in the mob. He never does — the brute — he always parades round the outside of the mob for all to see.

Typical Occasions

Consider the paddock sale of a line of hill country wether lambs. The vendor arranges with his agent to bring a buyer and a time is appointed. If the line is a very big one, say, 1,000 or more, have all the sheep mustered and the drafting done a day or so previously so that the sale stock can be put into a good paddock and brought into the yard only an hour or two before the buyer arrives. How often does one see stock tired, hollow and dirty after being in hand for several days — then presented in that state to the buyer. In this specific case of the wether lambs, it should be remembered that most hill country lambs vary considerably. There will be a handful of extra good lambs as big as their mothers, there will be a line of pretty good top lambs, a line of medium and certainly some culls. On second-class hill country, the averages of the four grades usually work out at super 5%, top 30 to 40%, medium 40 to 50% and culls 5 to 10%. The writer's advice is to draft them up before the buyer arrives into four lots. Then look the job over. If they are well drafted and look quite separate lines as to size and quality, show them thus. But if there appears to be little difference between one or two of the classes, box the two lots together again. If there are only a few of the super line put them out of sight in the woolshed and sell the main lines first. Then produce the few supers. If they are running with the main lot they look so good they make the others look ordinary.

If both sale and buyer have been good, let him have the supers at the same price as the tops. If he has been difficult or miserly charge a few shillings extra — a fine for bad manners of a bit over a penny a head over the whole line. The main point is that if the good sheep had remained in the main line they could have made the others look small and perhaps discounted the whole lot by one shilling per head. When drafting off the culls, make sure that all faulty lambs are in the culls — stags, or those deformed or undershot in the jaw.

Another typical case is the annual draft of cull ewes, for example, the cast-for-age line. Generally, these are five- or six-year-olds and are bought by fat lamb farmers. Very often one hears breeding farmers disparaging the fat lamb fellow because he has easy country, proximity to markets and towns, and generalizing to the effect that life is easy and profitable for him, compared with their own miserable lot. This may or not be correct, but it should be remembered that the fat lamb buyer is going to pay about double the price for his ewe purchase that he will get back in a year's time. When a fat ewe was worth 10s., a good five-year-old was worth £1; last year, for example, fat ewes were 20s. in February when five-year-olds cost £2.

With such a heavy depreciation he will naturally not want to buy any duds. Every ewe should be sound in all respects and the hill country vendor should see that his article *is* sound. A few faults that might be mentioned are ewes with unsound udders, bad feet, broken mouths or bearing trouble; those that are over-fat, or low condition or weak constitution. All these should be culled. Wool is of secondary importance and unless the buyer is known to have some particular theories or preferences about wool, there is no need to class or cull except where the wool fault is extreme or obvious.

MOUTHS

Any farmer (and there are many) who says of his aged-marked ewes, "Oh I never look at their teeth — they are all the one age so they must be all right", should know better. It is a very rare line of ewes that has exactly similar mouths right through. All sale ewes should be mouthed and any not up to standard taken out or at least marked and shown to the buyer. Mouths can vary tremendously even on one property — some paddocks are hard on teeth,

some easy. Several of the big Gisborne sheep vary from chisel mouths to gummies with one age of ewe. In passing it might be noted that one cannot be certain of the age of a ewe by looking at her teeth — a six-tooth ewe off ratstail country can be a gummy; an eight-year-old off very high rainfall country can still show chisel teeth; well-done three-year-old sheep will nearly always show a full four-year mouth, and so on. Mouth every ewe, and discard any not up to standard — in most cases the effort will be repaid twice over, first, by the price received for the ewes and, secondly, by the finding of at least a few young ewes wrongly age marked.

With a line of young ewes, all the above faults should be looked for and culled, but in addition some thought should be given to the wool. Possibly the buyer has it in mind to put the young ewe into his breeding flock and eventually retain the progeny. In most lines there will be a few extremely fine or very coarse, hairy-fleeced ewes which should come out as should any with weak wool on back or shoulder.

The same principles apply to lines of cattle. See that off-coloured or washy cattle are taken out of the mob — any odd ill-bred or horny beasts, stags, or those with hips down or faulty feet. In lines of breeding cows, take out any with malformed udders or those in very poor condition.

Presentation

Now a few words on the actual presentation of the stock and the vendor's attitude to his buyer.

One of the arts of salesmanship is display. Wares should be set out as attractively as possible. In the ordinary run of stock business there are various helps such as extra feeding, bloom dipping, trimming, branding, careful delivery to selling point, and careful selection of the selling point.

EXTRA FEEDING

If the year's operations have been planned carefully, the lines and quantities of stock that are going to be sold and the season of the year in which they will be sold will be known, therefore plan to have the line ready a month before selling time, plan to have useful paddocks of feed ready for that time, and give the sale stock this extra

feed. Bloom, condition and evenness will be greatly improved — as also the seller's reputation as a breeder-farmer.

BLOOM DIPPING, TRIMMING AND BRANDING

These points, of course, apply only to sheep, with the exception of branding, which applies also to cattle-breeders who brand their calves. The advice to these men is: Use a small brand and brand up on the neck where the brand will not devalue the hide. For the sheep man, the advice about branding is "don't". Nothing looks worse on a line of good sheep than big brand or raddle marks. A small dot of coloured paint on rump or back looks well — if there has been occasion to box some already drafted sheep, which must later be re-drafted, such as when sending several grades of ewes to a ewe fair.

Trimming and bloom dipping apply here not to stud sheep but to ordinary lines of grade stock. Trimming, of course, really means dagging. Elementary, one would think, but a look at the whole yarding at a sheep fair in the spring will almost certainly show that 10% of the pens have dirty sheep in them. The squaring off of the wool over the tail as is done by stud men with their rams pays off with good lines of sheep carrying a good coat of wool.

Bloom dipping has come in for criticism lately on the ground that it is unfair — but is it? Certain districts, such as Rotorua/Bay of Plenty, grow a whiter, harsher wool than, say, King Country or Wairarapa. The sheep can be just as good as regards bone, size, condition, or mouths — yet at auction the softer wool of the southern sheep would earn their wearers more money. So why not bloom the others? Many men make a living from their fellow men by buying their ill-prepared dairy heifers, taking them home, blooming them with extra feed, a cover for a week, or oiling the coat and clipping the tail and face and re-presenting them as they should have been in the first place.

No comment will be made on the practice of trimming and blooming stud rams and over-conditioning stud beef cattle. But as long as farmers show preference at auction for these dolled-up animals, the breeder is foolish if he does not prepare and present the article most readily bought. Unfair trimming is quite a different matter and will be discussed later in this paper.

SELLING POINT AND DELIVERY THERE

Two separate conditions apply here — selling at auction in saleyards and selling at home.

In the Saleyards

Most stock are shifted by motor lorry so the opportunity is available for lines to be drafted at home exactly as they are required to be offered, and loaded on the lorries accordingly. The agent at the yards then does not need to knock the stock about re-drafting. Do not try to save a few shillings by overloading sheep and thus have them down in the truck getting dirty. It is a good idea to let the stock empty out for an hour or so before loading.

Generally, stock sent to auction is surplus and really for sale; therefore, when offered a price for it, put it on the market and sell it. A willing vendor usually gets an extra bid or two. The only exception to this rule is when a really bad sale is experienced, then there should be no indecision — put a price on and, if it is not reached, take the stock home. But remember that next week the market could be lower, the stock look the worse for the trip, and that it costs quite a bit to cart them to and fro.

At Home — A Private Sale

Here is a chance to display a bit of salesmanship. Be ready at the hour appointed. Have the stock drafted and held in an easily accessible spot.

If possible have a good site for the sale — a slope up rather than a slope down; a pen to fit the stock — not too big or too small; a clean pen with some shade, and so on. Create a good impression. Then create a further good impression by greeting the buyer cheerfully and dealing with him agreeably. Even if one dislikes the fellow, always have some little "give" in readiness. Nothing helps a deal so much as a gesture towards, say, the cost of delivery or a reduction in price on a few small ones, or some such thing. A dour "take them or leave them" attitude is no help and the threat of another buyer waiting is worse still. A pleasant attitude is half the battle. Finally, if it is agreed to hold the stock for a period before delivery, feed them well; do not hold them in a starvation paddock.

TRIMMING STUD STOCK

If sheep are trimmed unfairly before being presented for sale, the action is a breach of fair trading practice

and could be the basis of a legal action. At shows, the judges feel a sheep carefully from neck to rump, perhaps parting the wool the whole way along, to make sure the carcass is smooth, with no lumps and no bumps. The farmer should do this when purchasing rams. If, on the other hand, he is a vendor of rams, no attempt should be made to cover definite defects by trimming the wool. He will sell only once to the man who buys the defective animal.

Buying Stock

The legal expression *caveat emptor,* "let the buyer beware", is one of the most significant statements ever made concerning contractual procedure. When a person sets out to buy something he is entering into a contract. He must examine the article, assure himself that it is up to description and that there are no obvious defects. Once he has bought the article, it is too late to discover faults or defects. They were there for him to see before he bought. Quite often the writer has been asked to get some redress for a buyer because of a defect in the stock that was plainly visible at the time of sale. This is particularly true of an auction sale; the buyer has already bought at a discount. The more careful buyers have seen the defect and lowered their value accordingly. If the fault had not been there, the price would have been higher.

Follow this course when buying at auction. Look round the whole yarding, select pens which look as if they would be suitable, then find out the background of the lines. Who owns them? Who bred them? What sort of country are they from? Only then, should the final selection for purchase be made. Examine the lines thoroughly and place a definite value on them. Do not be persuaded by the auctioneer or vendor to give more than this value. Particularly, do not be influenced by the fact that some well-known judge and buyer is still bidding above that value. He may know more, but also he might be spending someone else's money. When bidding, be clear and definite and final. If the auctioneer's attention can be gained, bid to him rather than to his assistants — it can save money. By the time the bid is relayed from clerk to auctioneer, someone else may have slipped in a bid, and yours following is raised by that amount. Also, the auctioneer's decision is final and in the event of a tight finish and a disputed bid at the whistle, the bid given to the auctioneer will prevail.

Selecting a Ram

Spend a lot of time and take great pains over the job when buying flock rams. Remember that, if they live a normal, useful life, each ram will leave up to 100 daughters in the flock. It is therefore of vital importance to get a good sire.

For the prime lamb breeds, the selection is more or less simple. Conformation and constitution are there to see. In the wool breeds more care is needed. First one should have a clear picture of the ideal — the style of sheep and quality of wool best suited to particular needs. Then one should try to pick a lot which on first glance appears to meet the specifications. If the breeder allows, select in this first stage three or four for every one required. Then really go to work.

Open the wool in four or five places and ascertain that the whole fleece is even — neck, shoulder, back, sides and britch. Discard the sheep which do not measure up. Then stand the ram up as straight as possible and with the flat of the hand feel right along the back from neck to rump. This is to make sure of a level back; no high shoulder, hollow back or droopy rump should be passed. Take a firm grip of the neck just above the shoulder to ascertain the strength and size — a weak ewe-neck must be avoided — feel for horns, look at teeth and jaw, then turn the ram up and examine hooves, knees and belly wool. It should not be necessary to examine the reproductive organs as this should have been done by a veterinarian.

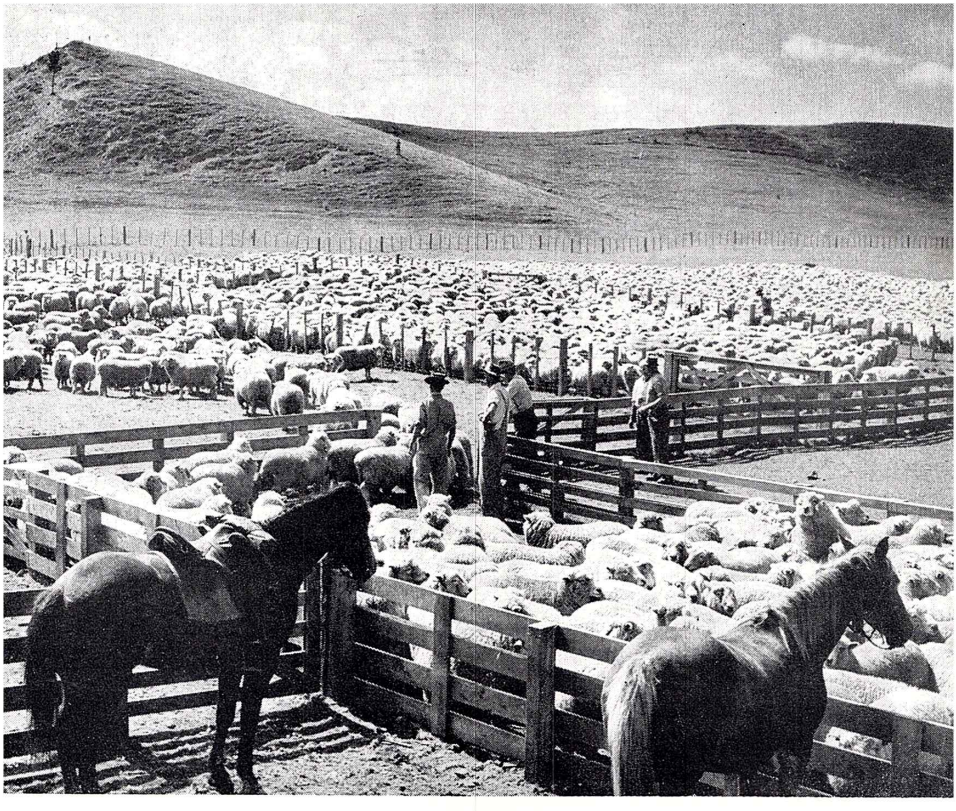
Only sheep which pass all these tests should be purchased.

Private Buying

A few words now on the place of the agent and the dealer in the stock market. Both men are important despite the constant criticism of the ill-informed farmer who brands them both as parasites.

THE AGENT

The part the stock and station agent plays in making available capital for farmers seeking to establish themselves or in development of their properties has been described elsewhere in this volume. One point that may need further emphasis is that the stock firm does not lend out money simply to earn interest — the firm uses it to direct commission earnings its way.



Good presentation of stock, easily accessible, creates a favourable impression on the buyer.

Servicing a farmer as a stock agent is an expensive matter — salaries, cars and expenses are high — so if all the stock company is going to get is interest on money it would be better advised to take 1% less and put the money out on mortgage. As it is, the company selects accounts for advance purposes where there will follow commissions and profits — wool, stock and merchandise.

Exchange of any commodity is virtually impossible without a middle-man — whether he be merchant, producer board or agent. Farmers cannot find buyers for their various types of products themselves unless they leave their farms and go out looking for markets. What always happens in new settlements, many of which have been established on the co-operative plan, is that soon one person is set aside to handle the marketing of the produce and he is paid to do it.

Select an agent and trust him to handle all the business. If he is dependable, and that will soon be evident, he will

give your interests preference ahead of those customers who give him only a portion of their business or who employ an agent only when they cannot sell their stock privately.

Without the stock and station agent, his finances and his marketing ability, farming would have been hard put to it to have survived the slumps of 1921 and 1932–3. Today the stock companies' finance is playing an even more important part. The rehabilitation scheme could hardly work without the stock company's aid. Finally, Tigger in the *Mercantile Gazette* of April 24, 1963, makes the point that "The stock agent will tell no lies — he has his own reputation to think of".

THE DEALER — THE PARASITE: A Fairy Story

Once upon a time, there was a drought in Hawke's Bay, Wairarapa and the Manawatu, and stock prices fell drastically. Some farmers in the Waikato heard of this and came down to pick up some stock at give-away prices. They were quite indignant to find that there were one or two fellows, who did not own a single acre, bidding on the stock at every sale till the pickings were not so easily got. "The fellows are parasites," they shouted, "they should not be allowed to buy stock for dealing."

Once upon another time, there was a surplus of cattle in Gisborne and the Matawhero yards were overtaxed and pens had to be filled, sold and refilled. Parasites arrived from Hawke's Bay, Manawatu, Waikato and Auckland. All the stock was sold.

Finally, in the year 2000, similar situations arose. At the instigation of the farmers' organizations, all parasites were in prison and auctioneers had been superseded. A handful of farmers arrived from the Waikato — they had no work to do, so could make the trip — they bought what cattle they wanted at their own price, leaving the rest behind and went home well satisfied. One fellow, however, sold his purchase to his neighbours at a nice little profit and sneaked away back all by himself to get some more. And so a new parasite was born.

Speaking generally, the dealer is an honest fellow — he has to be to sell his stock. In many ways, a buyer will get a better deal from a trader than he will from a farmer. In order to sell his stock, the dealer must be prepared to stand behind it with a guarantee, and mean it. So he will take out any beast that will not stand up to a guarantee.

Further, to keep his reputation, he must make allowances to the purchaser when requested by his agent — the sort of allowance a farmer would be reluctant to make.

One must be realistic. One knows, or should know, that the dealer keeps the market even (and honest) and that without him the markets would fluctuate tremendously. And, if it is any consolation, very few men have made money at stock dealing and a great many have gone broke.

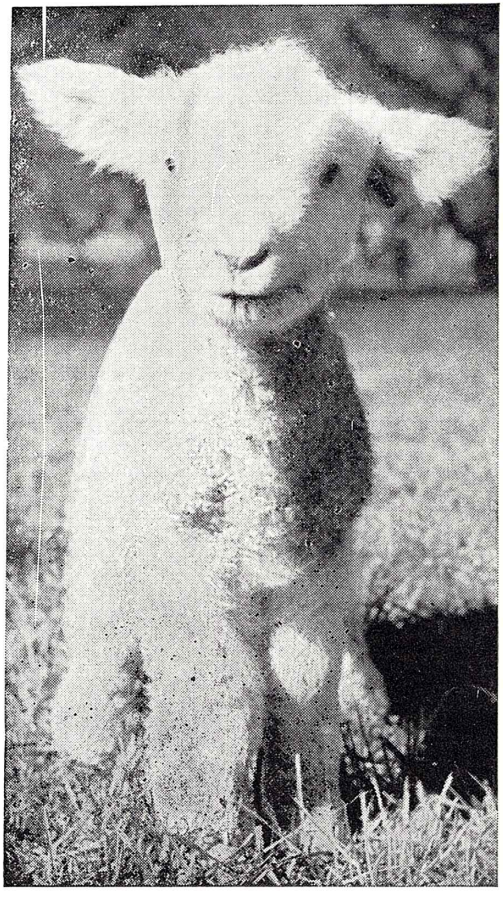
Summed up, experience has taught me that:

When selling, grade honestly and carefully and present the article to best advantage and use all one's most cheerful efforts to get a good price.

When buying, inspect, enquire, value, bid to that value, and stop.

DISCUSSION

COMMENT: While I was delighted to hear Mr McCaw condemning wool branding, I was horrified to hear him advocating the use of bloom dips. Woolbuyers dislike and penalize *all* types of artificial colouring in wool, and the Department of Agriculture has been giving this publicity for a long time. There is now considerable pressure on the Department to pass legislation banning the sale and use of bloom dips altogether.



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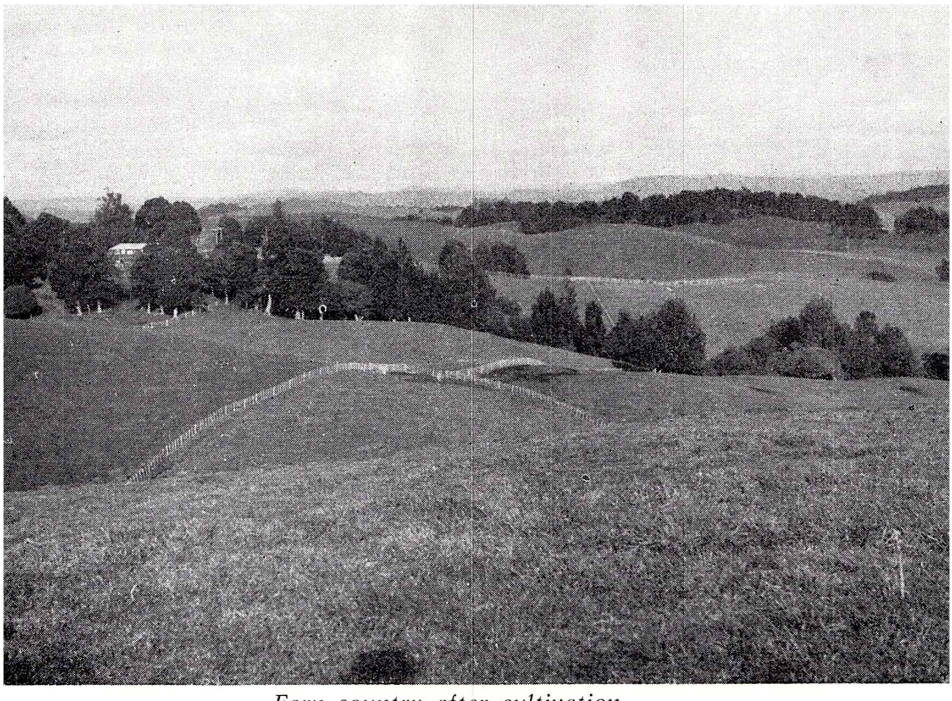

Fern country after cultivation.

PROBLEMS AND CHANGES IN NORTH KING COUNTRY FARMING

J. M. SOMERVILLE*

THE NORTHERN KING COUNTRY today is one of the most progressive and rapidly expanding areas in New Zealand, producing stock second to none; it offers great opportunities for men of energy and initiative and there is never a dull moment in the development of new country. Another thing which seems important is that there are people who have seen every phase of the growth and travail of this area and it is good to take advantage of their memories while they are still available.

For the purpose of this paper, the larger area involved can be taken to be the Waitomo County, an area of 1,300 square miles extending from the Kawhia Harbour to Mokau eastwards to Pureora and bounded on the south by the Mokau River. The particular area in which the writer is interested is twelve miles west of Te Kuiti and about halfway between the Waitomo Caves and Pio Pio, bordering on the Mairoa district. The history of the development and changes here is typical of much of the larger area.

* *"Waitepipi", No. 5 R.D., Te Kuiti.*

Early Settlement

The first phase in this story began after the turn of the century; it was pioneering as tough as any in the older districts sixty or seventy years before and it produced its full share of heroes and broken hearts. It was a case of going out into isolated, roadless districts with little more than faith, hope and the spirit of adventure.

The Mairoa district was settled in 1903–4 and the Troopers Road in 1905–6 with soldiers from the Boer War. Most of the country was covered with dense bush, although there were areas of open fern which were not regarded as so desirable in those days. In some ways the problems and hardships are best left to the imagination — felling and burning of bush, fencing and establishment of grass, building homes and bringing up families without any amenities whatsoever. There was speculation of the worst type when the initial fertility after the burns looked as if anything could be produced, and there was a general lack of appreciation that light country in an area of heavy rainfall and mild climate required special methods of farming.

Most of the early settlers came from Hawke's Bay, Taihape or Taranaki where grass could be farmed on orthodox lines and could be relied on to remain as grass. Here the grass quickly reverted to fern and second-growth bush and settlers had neither the knowledge, capital nor manpower to channel the strong growth into healthy production. At that stage the cream of the district's manpower went to the first world war and the deterioration of the half-developed land became more rapid. A short boom followed the war and then the first depression set in and it was at this stage, with the leaching away of the original fertility, that bush sickness became evident.

By this time many of the early settlers had abandoned their holdings and those that remained, as well as most of the second round of settlers, were forced to turn to dairying in order to get the necessities of life. This in itself brought a particular problem, that of ragwort, a problem that wrought havoc among the herds and damned the stock in the eyes of outside buyers for many years to come — a problem that still requires constant vigilance and control. Two other problems raised their ugly heads at this time, one, the realization that the Maori leases which had no

compensation for improvements were going to have a paralysing effect on any plans for development, and the other, rabbits, a subject which is best left underground.

The one bright spot at this time was the growing interest in the use of fertilizers, and, although there were a great many prejudices to be overcome, it gradually became apparent that this country responded to phosphatic fertilizers. In the year 1927–28 manure supplies passing through Te Kuiti Station reached the pre-depression peak of 6,715 tons. It is interesting to note that the only paddocks that had a reasonable sole of grass on this farm in 1937 were those that had been topdressed ten years earlier.

Then came the grimmest problem of all, "the depression". It was the very bottom; the bottom fell out of everything and the only escape from the flood of problems was for many the tragedy of "walking off". It is possible to have a "depression" complex and that in itself is a bad thing, holding back progress and initiative, but the folk who "hung on" through it all deserve the highest praise and admiration, particularly the womenfolk.

Depression Years

It is hard to picture what the depression did to the King Country. The country was only partly developed, it had no reserves of finance or fertility like the older-established districts. Thousands of acres were abandoned completely and many farms went back to the mortgagors; the rest hung on by sheer grit and determination, only to watch the rabbits, fern, bidi-bidi and ragwort slowly but surely reducing the carrying capacity.

A certain amount of this was brought about by the over-optimism and over-borrowing in the good years but the net result was that no lending institution would lend a penny on land in the King Country. Farms which today are bringing up to £50 per acre were going begging though some were sold at prices ranging from 10s to 30s per acre.

The roading system of the County was developed also by a system of heavy borrowing and so bad was the state of finances that in 1930 the total revenue of the County was barely sufficient to meet the loan charges and nothing whatsoever was available for roading itself.

One could go on without end recounting the hardships and financial losses at this time but, slowly but surely, with the rise in price for primary produce, the country once again began to change to grass from its rundown

and reverted state. However, it was a case of painfully slow and hard work compared with present-day mechanical means. Ploughing had to be done with hillside ploughs and brumby horses, topdressing all had to be done by hand after packing out on the steeper country.

Bush Sickness

Perhaps it would be of interest to those who have never experienced it to get some idea of how the bush sickness affected the sheep. Lambs would be born in the normal way and until the end of October or mid-November would grow and look the picture of health and then remarkably quickly would just fade away and die. The Bank of New Zealand farmed a property in the bush sick area at Mairoa and another on Troopers Road where there was no bush sickness and it was their policy to shift all the ewes and lambs down there at that time. However, one year they left it a bit late and what looked like big lambs could only be shifted at the rate of two to three miles per day. It is one of the miracle discoveries of modern science that such a small amount of cobalt would make all the difference between life and death to the sheep in bush sick areas. It is probably the greatest single factor in the rehabilitation of farming in the area.

Another important factor that should be mentioned was the work of the Land Development Branch of the Lands and Survey Department. This Branch, centred on Te Kuiti, began first with unemployed labour and gradually developed a most efficient farming organization first under the supervision of A. B. Jordan and then D. M. Greig. Practically all the abandoned and reverted land was brought back and has been resettled with returned soldiers, men who are taking advantage of modern methods and establishing the reputation of the King Country as a first-class farming community.

A few figures may be helpful at this stage as a basis of comparison. Fertilizer passing through Te Kuiti in 1930 was down to 4,000 tons. In 1939 it had risen to 10,500 tons and, although during the war it dropped to 4,750 tons, by 1960 it was 30,000 tons.

The sheep numbers are also very striking. From 1929 to 1938, the numbers in northern King Country doubled to reach 692,000, and in 1960 the number had reached 1,525,000. Mention could also be made of the change in quality of wethers to breeding ewes; of poor store lambs

Cows being fed hay on fern.

to prime lambs; of stained and seedy wool to bright and quality wool; of hard store cattle to breeding cows and fattening high class stock.

So the King Country in its short history has seen many changes and encountered many problems. Some farmers worked wonders, others saw their farms revert to fern twice and even three times, while others were completely broken. For the most part, it has been the third generation that has reaped the benefit of the labour and experience of the early settlers and it is a great satisfaction to them to know that after all the King Country has come into its own.

Personal Experience

This paper is concerned mainly with the writer's experience of farming in the area. The property of 600 acres came back to the family as guarantors and, as all efforts to sell it were of no avail, the writer took it over in 1937, after

seven years' experience in the South Island. Sound though that experience was, it was far removed from Te Kuiti and the conditions prevailing there. Although some good spade-work had been done in fencing and crushing fern, there was still a long way to go. Except for the two paddocks topdressed ten years before and about 20 acres that had been cropped, fern, bidi-bidi and danthonia covered all the rest. Limited capital allowed only 20 tons of fertilizer to be applied and that dropped to six tons during rationing. The position faced was similar to that faced by most private farmers, though many were still milking on sheep country. The general idea was to starve as many stock as possible through the winter in an effort to control the fern in the spring. There was really no feed until the fern came in October and the first two winters were a nightmare. Most of the early spring was spent pulling cattle and sheep out of bogs and once the neighbour's horses were so weak that they got stuck trying to extricate a cow and had to be pulled out as well. Stock losses were about 20% and it was no wonder that profit was very small. It became very evident that three factors were essential for success:

(1) Sufficient fertilizer to make the fern palatable, to improve stock health and to establish high-producing grass.
(2) Fencing to enable proper control of fern, etc.
(3) Proper provision for winter feed to reduce stock losses and to bring them into the spring, strong enough to work and to breed.

The soil is of volcanic origin overlaid with bush loam, is free draining and responsive to phosphatic manure, and fortunately all the area grows good crops of turnips, swedes and choumoellier.

Cultivation

Cultivation was a most arduous task. All spare time in autumn and winter was spent clearing the country of logs and rubbish and ploughing new rough and steep country in the old way, and had to be experienced to be believed. Of all the men who had to leave their farms, the most tragic was one who, over thirty years, had cleared and ploughed five hundred acres and walked off with only a pension. He refused to topdress and, faster than he could break in new country, the fern took possession of what he had already cleared.

However, those who ploughed and grew winter feed were the first to make progress. The extra stock wintered without losses paid for the crop itself, the good grasses which were established were a permanent investment and the new look a farm takes on after re-grassing is as good as a tonic. Over the years good seed of permanent strains has always been sown on the writer's property and pastures generally bear out the wisdom of such a policy. Grass has always had to be sown by hand and consolidation has been achieved by tramping with sheep both before and after sowing. Perhaps more care was taken years ago — in any case, the best pastures on the farm have been sown down more than twenty years.

The advent of bulldozers for stumping and levelling, the giant discs to replace the plough, and the roller and seed box for sowing grass, have taken much of the drudgery out of agricultural work and although it is costly it always pays to establish good pasture.

Fodder Crops

The time eventually arrives when the farmer has to consider whether he will grow any fodder crops at all and on a great many King Country farms this is not now general practice. The real winter without growth has been shortened so much that, with proper conservation of grass in the autumn, this is working out remarkably well. Eight to ten acres of swedes are still grown, most being fed to the hoggets, the only other winter feed being hay. All the ewes except the two-tooths get hay for six weeks enabling the feed to be conserved for the cattle and to boost the ewes as lambing approaches.

The cattle get most of their hay in July and August and sometimes into September; this programme suits well and is a big change from 30 to 40 acres of swedes each year.

Topdressing programmes have also changed considerably and must continue to change as the elements are leached from the soil or used up and new elements become necessary for stock health. Superphosphate has been the primary fertilizer. The addition of cobalt to it has proved the most effective way to supply this element and in the bush sick areas it is still necessary from time to time. Serpentine superphosphate has also been effective and popular, as has super-lime. The potash content of the soil which was high after the burns has dropped alarmingly and it is becoming standard practice to apply it in conjunction with superphosphate or serpentine.

In the days of hand-sowing, the soundest procedure was to throw the fertilizer into the fern and make the cattle go after it. Many tales are told of crafty topdressers who threw whole bags into the fern or down tomos and a lot certainly made the mistake of topdressing only the grass. The aeroplane has been one of the greatest boons to modern farming and has enabled fertilizer to fall on rocks and rough places with the result that grass is growing where it never grew before. It took a month of hard slogging to sow the manure that the plane can now sow easily in one day.

Droving is another job that the farmer is saved by modern transport. On the day of the annual ewe fair, one could count fifteen mobs of sheep being driven down the road to Te Kuiti; what a job it was, but nothing to the thrills one could get trying to take touchy cattle through town over dahlia beds and lawns and past trains.

King Country farming before the war was tough and full of problems but it had its compensations. The practical experience is something one would certainly hate to be without. One had to be his own builder, blacksmith, bushman, veterinarian and jack-of-all trades but it is surprising what could be done, and the writer is under a great debt to those practical men who had lived here for many years from whom so much was learned.

Current Problems

There are still problems today as there always will be with farming anywhere. From being bush sick and unsaleable, the land now raises the problem of becoming too dear. With heavier stocking, stock health is not just a matter of cobalt and superphosphate but will always need the best brains of farmer and scientist. The work of the Department of Agriculture and kindred organizations has done much to help.

A problem that appears to be going to cause concern and research is the dropping fertility of many ewe flocks and the lower weights for prime lambs, though this is not confined to the King Country. Grass staggers among run cattle is forcing a number to change from breeding to fattening. Grass staggers, like facial eczema, was completely unknown in the days of fern.

Thanks to the energy and foresight of the Wairere and Waitomo Electric Power Boards, electricity has been taken to even the most inaccessible places. This has been a great

boon. Communications are a long way behind older-settled areas but steady progress is being made and at least everyone has a metalled access, though, because of the nature of the country, roads will always be narrow and tortuous.

One serious problem that so far has defied successive Governments is the question of Maori land. Only forty per cent. of the Maori rates are collected by the County and that is a fair assessment of the amount that is being farmed. It is not unfair or unrealistic to say that a solution to this could and must be found. It is a blot on the landscape and a tremendous loss to the economy to allow good land to remain out of production.

Achievement and Promise

The change that has come to the King Country during the last thirty years, and particularly since the war, has to be seen to be believed. The farm directly opposite the writer's had 150 of the hardest case sheep imaginable, with about three pounds of wool on the back and sides like a saddle and the lambs completely brown with bidi-bidi. Today the same place has 1,200 sheep and 150 cattle. All the bush sick country, such as Mairoa, is carrying three ewes to the acre as well as cattle. The writer's place has gone from 800 ewes and 80 cattle to 1,400 ewes and 600 hoggets and 250 cattle.

But that is not the end by any means. Sir Bruce Levy, speaking in Te Kuiti during the last war, said that he envisaged the time when this part would carry five ewes to the acre or better. They were not idle words — this has been accomplished in many cases. There is no limit to the increase in production possible in New Zealand and it is new areas such as this that have the greatest potential.

The King Country has at last overcome the stigma, the problems and handicaps that at times have appeared too hard to bear and it has emerged strong and progressive, producing first-class sheep and cattle and taking its full part in producing the primary produce so essential to the whole country.

DISCUSSION

Q:: *Would the speaker elaborate on the technique of development from fern and scrub to pasture with special reference to cutting, burning, cultivation and topdressing?*

A:: Where fern has complete control, the general practice was to burn and surface sow good grass. In some cases two burns were necessary to get down to the ground. Where land was part fern and part grass it was found best to topdress the fern first and crush with cattle. In either case, initial topdressing with 3 to 4 cwt of super brought quickest and most effective results and stock did particularly well on new burns. Particular attention had to be given to obtaining complete control from October to January.

The best crops were obtained after the fern had been controlled for a number of years and the soil sweetened and fertilized.

Q:: *How do you deal with ring-fern?*

A:: Ring fern is considerably harder to eradicate than bracken. On this farm it was confined to the back faces which were also generally the steepest. Once the easier country was cultivated and good grasses established, the cattle made short work of the ring fern, as they seemed to need the harder fern as an aid to proper digestion. On neighbouring farms where ring fern had control, topdressing has been the most important factor and has been most successful, provided sufficient cattle were used.

Q:: *Which is the better method — ploughing or giant discing?*

A:: I do not think any ploughman would say the giant disc was a better implement than the plough for complete cultivation. However, on new country the giant disc has done a wonderful job at a much cheaper cost. It is a good leveller and generally good crops follow. It has the great advantage of being able to ride stumps and debris that would have to be cleared for ploughing, and so has greatly accelerated the breaking in of virgin land.

Q:: *Was lime also used in the development of the farm?*

A:: Although soil tests reveal the fact that at least one ton of lime is necessary on the soil, I must confess that I have not used it to any extent. I have sown two paddocks with one ton per acre and although they are very good, they are not noticeably better than those without lime.

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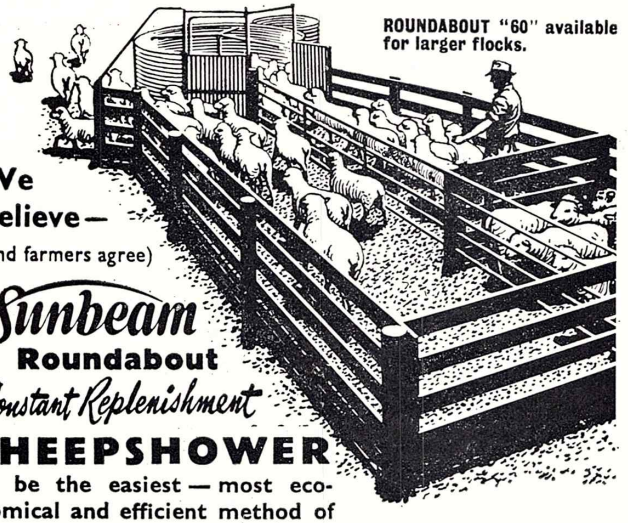

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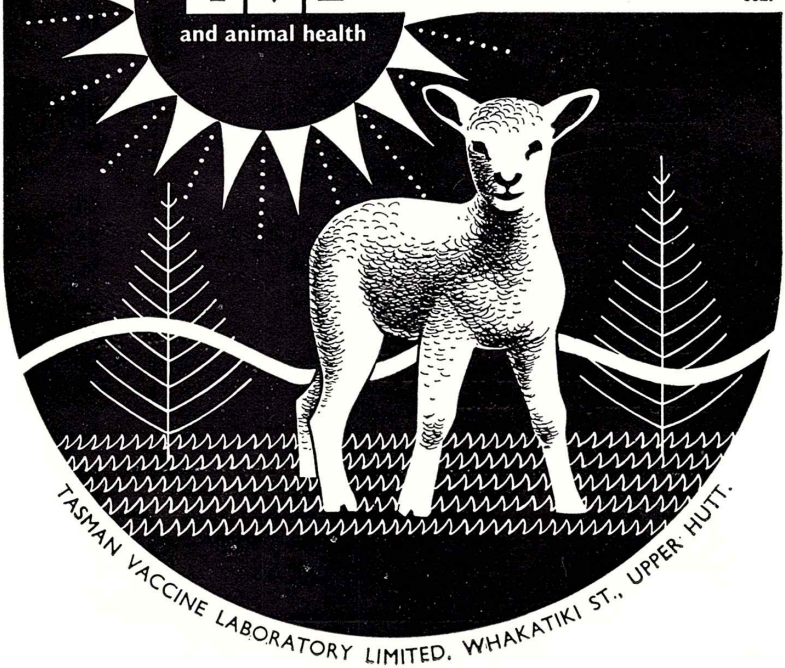

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URBAN GROWTH

With Particular Reference to Palmerston North

B. G. R. SAUNDERS*

THIS PAPER falls into three parts: first, the growth of urbanism is discussed; second, the possible future population growth of the Manawatu region is presented; and third, the future growth of Palmerston North is reviewed in the light of its needs for territorial expansion.

The Growth of Urbanism

During the past 150 years, urban expansion in the world has gone ahead much faster and has reached proportions far greater than at any previous time in history. In 1800 only 2.4% of the world's population lived in cities of 20,000 or more, but in 1950 the proportion was 20.9% (1). This development — a true urban revolution — has in-

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volved not only the rise of new towns and cities, but also the creation of genuine urbanization in the sense that a substantial proportion of the population now lives in towns and cities.

The urban growth of England and Wales, especially during the nineteenth century, well illustrates this rapid expansion. (England and Wales are usually considered together for many British official administrative and statistical purposes.) In 1801 the population of these countries was 8.89 million, of which 78% was classed as rural (it should be noted that even at this date England and Wales were already in the van of urban development and presented a degree of urbanization not achieved by any other country until after 1850), while in 1901 the population was 32.53 million, of which 80% lived within the boundaries of urban administrative areas. Thus, in a period of 100 years, both the total population and the percentage which lived in an urban environment increased almost fourfold. Since 1901 the percentage of urban population in these countries has not changed significantly, although the total population has increased to over 46 million.

URBAN GROWTH IN NEW ZEALAND

In contrast, New Zealand's move towards advanced urbanization has been particularly pronounced during the present century. In 1901, approximately 43% of the total European population of 707,304 lived in towns with a population of 1,000 or more, while in 1961 the proportion was 66% of a total of 2.25 million. As will be noted, this degree of urbanization is well below the stage reached by England and Wales. However, it should be borne in mind that a more realistic appraisal of the extent of urban development in New Zealand would be given if the populations of the eight counties, which are either wholly or partly in the urban areas of Auckland, Wellington-Hutt and Christchurch, were classed as urban*. The total population of these counties in 1961 was 192,435 — that is, 8% of the total population of New Zealand.

* With the rapid growth of population, administrative boundaries are not always a realistic guide to the degree of urbanization and the amount of the rural population. Smailes (2) records that only 2 million people in England and Wales live at the same time more than ten miles from a city and more than five miles from a town, and suggests that for these countries perhaps this is the most telling answer to the question: "How large is the sector of the population of England and Wales that today lives under rural conditions?"

Two features of the present urban pattern in New Zealand deserve stress:

(1) Over one-half of the urban population lives in cities. In 1961, 35% of the total population of New Zealand lived in cities. The four main cities, with a total population of over 450,000, accounted for some 20% of this proportion. Important smaller provincial cities included Hamilton, Wanganui, Palmerston North and Invercargill.

(2) The North Island contains by far the greater urban population of the two islands. In 1961, over 1 million lived in the urban centres of the North Island, but only 452,010 in the urban centres of the South Island.

URBAN GROWTH IN THE MANAWATU (see Table 1)

The degree of urbanization reached in the Manawatu region* falls slightly above the New Zealand average, but slightly below the average for the North Island. In 1961, approximately 67% of a total population of 92,225 lived in the six urban centres of the region. Palmerston North (41,014), occupying a favourable position on the North Island rail network and situated in the centre of a large productive tributary area, was by far the largest urban settlement and had a population some five times greater than that of Feilding, the second largest town in the Manawatu. In 1961, the five minor urban centres had a total population of 23,105, which represented 24% of the regional urban population. Shannon, with a population of only 1,398, was one of the smallest boroughs in the North Island.

Urban growth in the Manawatu was particularly rapid following the second World War. With the exception of Otaki, all the urban centres experienced between 1945 and 1951 population increases of over 50%. The most impressive expansion took place in Levin where the population increased by 140% — from a total of 3,259 to 7,934. During this period, but particularly between 1945 and 1951, Levin was one of the fastest growing boroughs in New Zealand. Its latest intercensal percentage increase, however, was less than one-half that witnessed between 1945 and 1951. Substantial increases in population also took place in Palmerston North and Feilding and in both of these centres the population increased by over 60%. Feilding's expansion

† For the purposes of this paper, the Manawatu region is taken to include the geographic counties of Kiwitea, Pohangina, Oroua, Manawatu, Kairanga and Horowhenua.

TABLE 1: Population Totals and Increases for New Zealand and the Manawatu

	Population			*Numerical Increase & Percentage Increase*			
	1945	*1961*	*1981*	*1945–61*		*1961–81*	
NEW ZEALAND	1,702,298	2,414,984	3,649,000	712,686	41.9	1,234,016	51.1
NORTH ISLAND	1,146,292	1,684,785	2,621,750	538,493	47.0	936,965	55.6
SOUTH ISLAND	556,006	730,199	1,026,850	174,193	31.3	296,651	40.6
MANAWATU REGION	64,986	96,225	146,750	31,239	41.9	50,525	59.1
ADMINISTRATIVE COUNTIES:							
Kiwitea	2,182	2,339	2,250	157	7.2	– 89	– 3.8
Pohangina	1,258	1,199	1,000	– 59	– 4.6	– 199	– 16.6
Oroua	3,722	4,559	4,400	837	22.2	– 159	– 3.5
Manawatu	6,245	7,288	9,000	1,043	16.7	1,712	22.1
Kairanga	5,669	6,160	15,000	491	8.7	8,840	143.5
Horowhenua	7,754	10,561	17,000	2,807	36.2	6,439	60.9
P.N. URBAN AREA	27,294	43,185	74,000	15,891	58.2	30,815	71.4
P.N. CITY	25,277	41,014	63,000	15,737	62.3	21,986	53.6
BOROUGHS:							
Feilding	5,001	8,172	13,500	3,171	63.4	5,328	65.2
Foxton	1,651	2,628	3,500	977	59.2	872	33.2
Levin	3,259	7,934	12,000	4,675	143.4	4,066	51.3
Otaki	2,042	2,973	4,000	931	45.6	1,027	34.5
Shannon	922	1,398	2,100	476	51.6	702	50.2

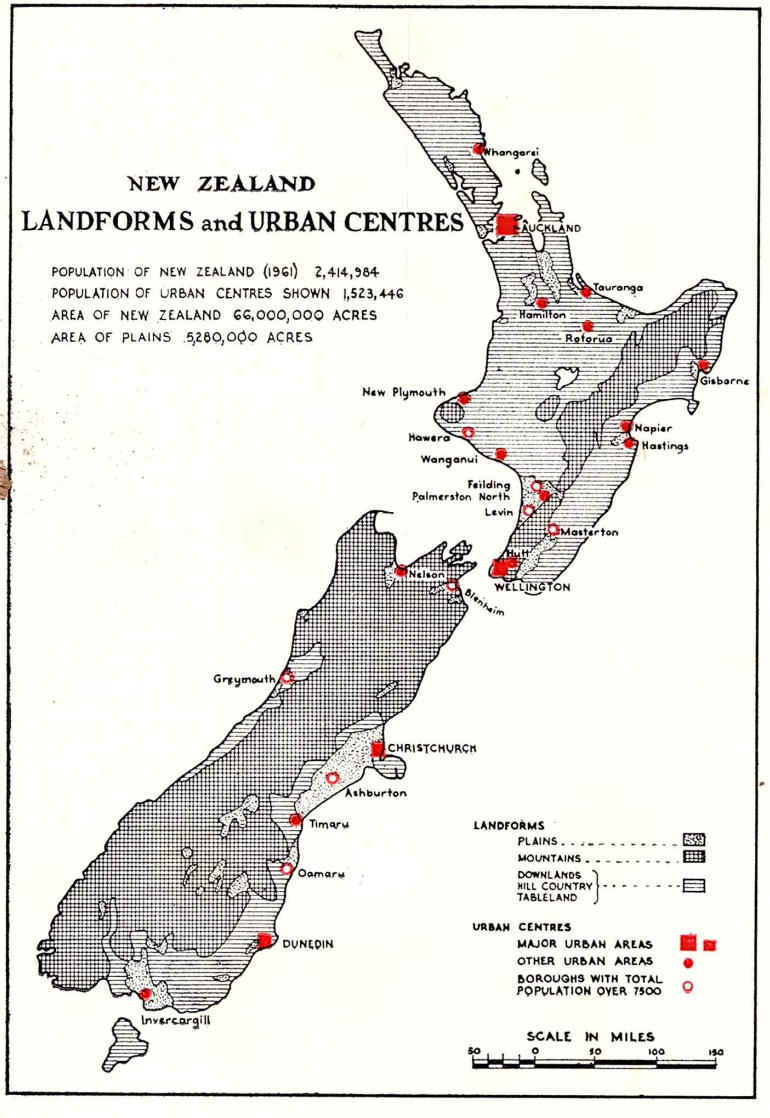
NEW ZEALAND
LANDFORMS and URBAN CENTRES
POPULATION OF NEW ZEALAND (1961) 2,414,984
POPULATION OF URBAN CENTRES SHOWN 1,523,446
AREA OF NEW ZEALAND 66,000,000 ACRES
AREA OF PLAINS 5,280,000 ACRES
Whangarei
AUCKLAND
Tauranga
Hamilton
Rotorua
Gisborne
New Plymouth
Napier
Hastings
Hawera
Wanganui
Feilding
Palmerston North
Levin
Masterton
Nelson
Blenheim
WELLINGTON
Greymouth
CHRISTCHURCH
Ashburton
Timaru
Oamaru
DUNEDIN
Invercargill
LANDFORMS
PLAINS
MOUNTAINS
DOWNLANDS
HILL COUNTRY
TABLELAND
URBAN CENTRES
MAJOR URBAN AREAS
OTHER URBAN AREAS
BOROUGHS WITH TOTAL POPULATION OVER 7500
SCALE IN MILES
50 0 50 100 150

FIG. 1

deserves special comment, for throughout the post-war period the intercensal percentage increase of population rose steadily and reached over 20% for 1956–1961. The small borough of Shannon also experienced a similar trend in expansion. Between 1945 and 1951, Shannon's population increased by 13%, but between 1956 and 1961 it increased by 18%. Although Foxton and Otaki showed relatively large increases in population between 1945 and 1961, it should be noted that much of their growth took place in the early part of the period. For example, between 1945 and 1951 the population of Foxton increased by 575 (35%), but between 1956 and 1961 by only 103 (4%).

During the period 1945–1961, the population of the counties increased by just over 5,000, or by some 20%. Horowhenua was the most successful county and increased by 2,807, a total which was greater than the combined increases of the other five counties. Growth was particularly marked in the settlements of Opiki, Kuku, Manakau, Te Horo and Waikanae. In contrast, the population of Kairanga increased by only 491. The overall increase of over 1,000 shown by Manawatu was in large measure due to the development of the several beach settlements and consolidation in the main inland centres of Carnarvon, Rongotea and Sanson*. Pohangina was the only county to record a net loss of population over the period. Between 1945 and 1961, the population decreased by 4.6%. A similar loss of population is now taking place in both Kiwitea and Oroua. Although these counties showed a net gain of population between 1945 and 1961, both experienced a net loss between 1956 and 1961. This trend is expected to continue, for the main reason behind the exodus is the limited employment opportunities which exist in the counties.

Future Population Growth in the Manawatu

To what extent will urban growth continue in the future? Speculation concerning the future of urbanization is naturally hazardous. Nevertheless, urbanization is now so widespread and so much a part of twentieth century society that its continued growth in New Zealand appears certain.

The Town and Country Planning Branch, Ministry of Works (3), has estimated that between 1961 and 1981 the

* The population of Ohakea (settlement and RNZAF station) was 986 in 1945 and 899 in 1961. Thus, the increase shown by the county is not to be attributed to developments at Ohakea.

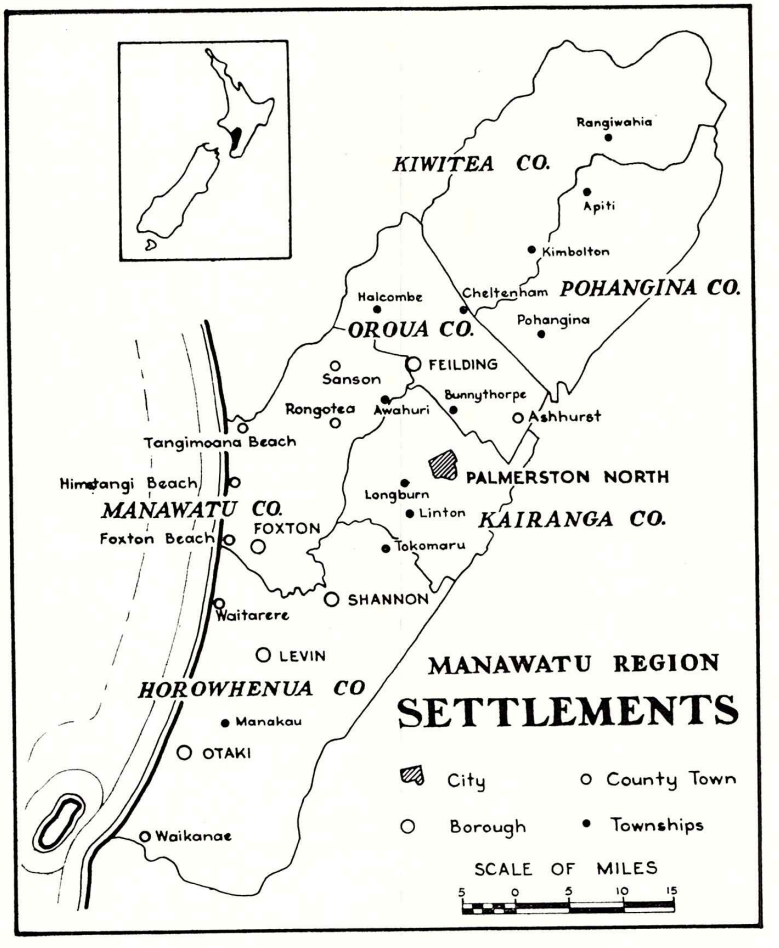

FIG. 2

population of the Manawatu region will increase by just over 50,000, which represents an increase of 60% over the population total for 1961* (see Table 1). This percentage increase is slightly higher than that forecast for the North Island as a whole. Of the regional increase, 67% is expected

* The estimates of future population made by the Town and Country Planning Branch were based on: the projections of national population growth made by the Government Statistician; past trends in population growth; and major factors likely to affect population growth.

to locate within the urban centres, and 33% within the counties. More particularly, the following appear to be the main features of future growth in the Manawatu:

(1) Over 50% of the regional increase is expected to take place in the Palmerston North urban area and by 1981 the urban area is expected to have a population of approximately 74,000. The growth rate of the urban area between 1961 and 1981 (71.4%) will be considerably higher than the rate experienced in the larger urban concentrations (for example, Auckland, where the increase is expected to be 50%), but considerably lower than the rate experienced in the smaller urban areas of the northern half of the North Island (for example, Rotorua, Hamilton and Tauranga, where the increases are expected to be round 100%). An important feature of the growth in the Palmerston North urban area will be the increase in population outside the present administrative boundary of Palmerston North city. The city itself is expected to increase at an average rate of 1,000 per year.

(2) The boroughs of Feilding, Foxton, Levin, Otaki and Shannon are expected to receive 23.5% of the regional increase. Feilding's growth during the period is expected to exceed 5,000 and its percentage increase will be the highest witnessed in the boroughs. Levin and Shannon are expected to increase their 1961 populations by at least 50%, and Foxton and Otaki their 1961 populations by at least 33%. The numerical increases for both Levin and Foxton are expected to be lower than their respective increases for 1945 to 1961, although in the case of Levin future borough boundary changes may alter the picture.

(3) The counties of the Manawatu region are expected to receive 33% of the regional increase. However, the increase is expected to be confined to the counties of Kairanga, Manawatu and Horowhenua, for the three hill country counties are expected to show net losses of population. Over 90% of the increase in the counties is expected to take place in Horowhenua and Kairanga — in the former county the increase is expected to concentrate in the Waikanae and Levin areas, and in the latter county in the Palmerston North urban area. The significant feature with regard to the increase of population in these counties is that numerically the total increase is expected to be almost five times greater than that recorded for the period 1945 to 1961.

Palmerston North's Problem

Between 1961 and 1981, the population of Palmerston North is expected to increase by 22,000 (that is, by some 54%) and to reach a total of approximately 63,000. The vital question is: Can this increase be accommodated within the present city boundaries?

The land-use pattern of 1961 and the future proposed land-use pattern (4) are shown in Table 2. It will be noted that the proposed pattern involves an increase of 875 acres in residential land over the acreage in 1961. At the present residential density of 16 persons per acre, this should provide for a population increase of 14,000, which, on the basis of the expected population increase of at least 1,000 per year, should be acquired by the mid-1970s. This means, of course, that unless appropriate action is taken Palmerston North will be unable to deal with all of its expected growth prior to 1981.

TABLE 2: The 1961 Land-use Pattern (in acres) in Palmerston North and the Proposed Future Land-use Zoning Pattern

	1961	*Proposed*
Residential	2565	3440
Industrial	130	410
Commercial	80	120
Local shops	10	20
Reserves	540	640
Schools	140	190
Railway	30	200
Streets	1430	1700
Land outside stopbank	200	200
Aerodrome	200	200
Streams and lagoons	40	40
Railway reserve	200	—
Undeveloped	1595	—
TOTAL	7160	7160

Three solutions could be adopted to meet this problem of population growth: first, residential densities could be increased; second, the city boundaries could be extended; and, third, other urban centres could be developed as overspill towns, dormitory "suburbs" or "new" towns.

INCREASE IN RESIDENTIAL DENSITIES

The overall population density of Palmerston North is 5.7 persons per acre, which in comparison with certain oversea standards is an extremely low density. For example, Birmingham, the chief city of the West Midlands Conurba-

tion, has a population density of 22 persons per acre, while Rowley Regis, a municipal borough within the conurbation and one with approximately the same population as Palmerston North, has a population density of 11.7 per acre. This lack of high-density development in Palmerston North reflects the most outstanding feature of settlement in New Zealand (even Christchurch city has an overall density of only 5.8 persons per acre) and it appears unlikely that the pattern will be changed materially within the near future. To do so would present an unpredictable challenge to New Zealand's accepted way of life. Thus it appears that Palmerston North will have no alternative but to extend its boundaries within the near future in order to accommodate its increase of population. However, it is interesting to note that, if 10% of the population of Palmerston North* were interested in living in flats on the basis of 99 persons per acre (a density which is permissible in special areas such as those adjacent to the central business district or those adjacent to industrial sites), then the expected population increase between 1961 and 1981 could be accommodated within the present city area and could also enjoy the generous housing density that prevails at present.

EXTENSION OF THE CITY BOUNDARIES

The estimates of future population made by the Town and Country Planning Branch indicate that, for residential purposes alone, the city will need to acquire an additional 500 acres before 1981. In effect the demand will be greater. After 1981 it is expected that the city will require for expansion 1,000 acres in every ten years. This demand raises the most critical problem of the direction in which urban expansion should take place.

In summary the following appear to be the main features involved in the further expansion of Palmerston North (see Fig. 3):

(1) The Manawatu River presents a natural barrier to development to the south of Palmerston North and although at some future date this barrier may be surmounted, at present expansion is not envisaged in this direction. In addition, land ownership on the Massey side of the river presents a major problem to expansion.

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* The new towns of England and Wales which have been developed since 1945 have planned for some 2.5 to 14% of their populations to be accommodated in flats.

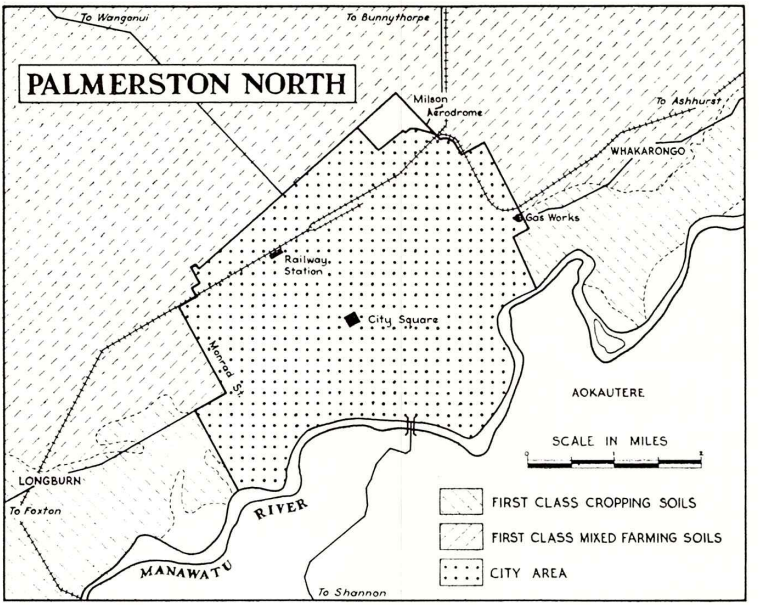

FIG. 3

(The soil classes are based on the scheme proposed by the N.Z. Institute of Agricultural Science and have been defined by the Soil Bureau, D.S.I.R., Palmerston North.)

(2) To the west of the city lie the fertile Manawatu and Kairanga soils and as far as possible these soils will be retained for agricultural use. (In any case, drainage in the Kairanga soils is poor and many problems would be experienced in extending urban development on them.) Some extension of the urban area near Monrad Street is expected because the locality is already serviced and could be more fully developed without large expenditure.

(3) In the near future, no development will take place to the north and north-west. Two factors are involved in retarding urban expansion in these directions: first, the presence of Milson aerodrome; and, second, the poorly drained and lowlying Kairanga soils. The provision of an adequate sewerage system for any development in a northwest direction would probably involve great cost.

(4) The first extensive urban expansion is expected to take place towards the northeast. The area possesses

several advantages of site and can also be easily serviced. Early development will probably be confined to the yellow-grey earths of the terraces, although at a later date it is expected that some of the fertile Manawatu soils will succumb to urban growth. However, this latter development should not be viewed with alarm for it can be safely assumed that any expansion on to high-class soils will take place only where it is essential for orderly growth.

To date no official policy has been formulated with regard to the ultimate size of Palmerston North. It would seem, however, that the time has arrived for careful thought on this problem, for the continued growth of the city at the present rate and on the present pattern will result in a settlement of over 100,000 on an extended site at least twice the present size by the year 2000. From the regional viewpoint it may be advisable to limit the size of Palmerston North and to channel much of the growth of population after 1981 either into the other boroughs of the Manawatu or into a number of specially planned "new" towns.

"OVERSPILL" EXPANSION

It will be appreciated that, in the interests of society, town planning has as its major challenge the mastery over current urban growth and expansion trends. Sociologically, the best community life is provided in small, reasonably low-density communities. This implies that redevelopment and consolidation within a larger city should be preferably in the form of neighbourhood units and communities and that further growth of a city beyond its functional size should be accommodated, not in the city itself, but in new towns and the controlled expansion of certain already existing small towns.

An interesting planning technique for controlling urban expansion is offered by the development of new towns. The idea of new towns is not new. The movement for modern new towns in Britain owes something to the lead given sixty years ago by the pioneer private enterprise villages of Bournville and Port Sunlight, although it has only been since the passing in 1946 of the New Towns Act that the movement has reached any significant practical expression. In their larger inception, new towns are clearly a matter of regional planning. For example, the policy behind their creation in Britain has been the dispersal of industry and population from overcrowded cities.

In New Zealand, an appropriate policy behind the construction of new towns could very well be the protection of the country's fertile soils from urban encroachment. Unfortunately, New Zealand's resources in first-class soils lie near to the main urban centres and thus they are in constant danger of being built over — as will be seen from Fig. 3 Palmerston North is encompassed by first-class land. But by the planned development of new towns on soils of low productivity it should be possible to conserve the fertile soils for the production of food.*

Ashhurst and Himatangi have been suggested as possible sites for new towns in the Manawatu. Both occupy satisfactory geographic situations, although the presence of the railway at Ashhurst would give that centre an initial advantage. However, new town development can become a reality only under national legislative control and until such time as this is established no progress can be made in this direction in the Manawatu. Nevertheless, it may well pay the region to give thought now to this kind of development so that its full potentialities may be assessed.

Unfortunately, space does not permit a full discussion on the possibilities of consolidation within the existing boroughs in the Manawatu. However, it should be noted that these boroughs already possess most of the essential services and have invested in them a considerable amount of capital. Thus, consolidation and expansion in these centres would be easy to achieve and would undoubtedly be of benefit to the region as a whole. Obviously this development should precede that of the development of new towns.

Conclusion

In summary, the following are the three significant points of this paper: first, urban growth in the Manawatu region is expected to continue until 1981 at a rate at least equivalent to that experienced between 1945 and 1961; second, Palmerston North is expected to expand its city limits within the near future and is expected to make further demands on adjacent territory as its population increases;

* Raeside (5) has suggested that two suitable South Island sites for such towns would be the stony and shallow soils in the neighbourhood of Rolleston, and the stony and shallow soils of the Waitaki delta.

and third, the time has been reached when the Manawatu should embark on regional planning so that its total future population growth may be planned and orderly.

Acknowledgements

To K. Nairn (Town Planner, Palmerston North) and J. D. Cowie (Soil Bureau, D.S.I.R., Palmerston North). V. Warren for drawing the maps.

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NOTE: Population statistics for New Zealand were obtained from the population censuses (Vol. I. *Increase and Location of Population*) for 1945, 1951, 1956 and 1961.

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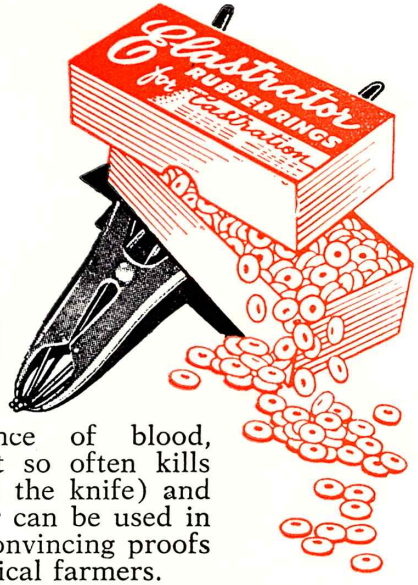

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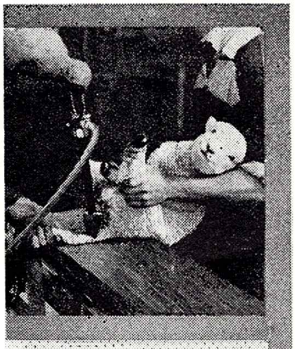

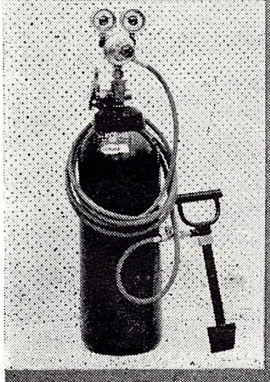

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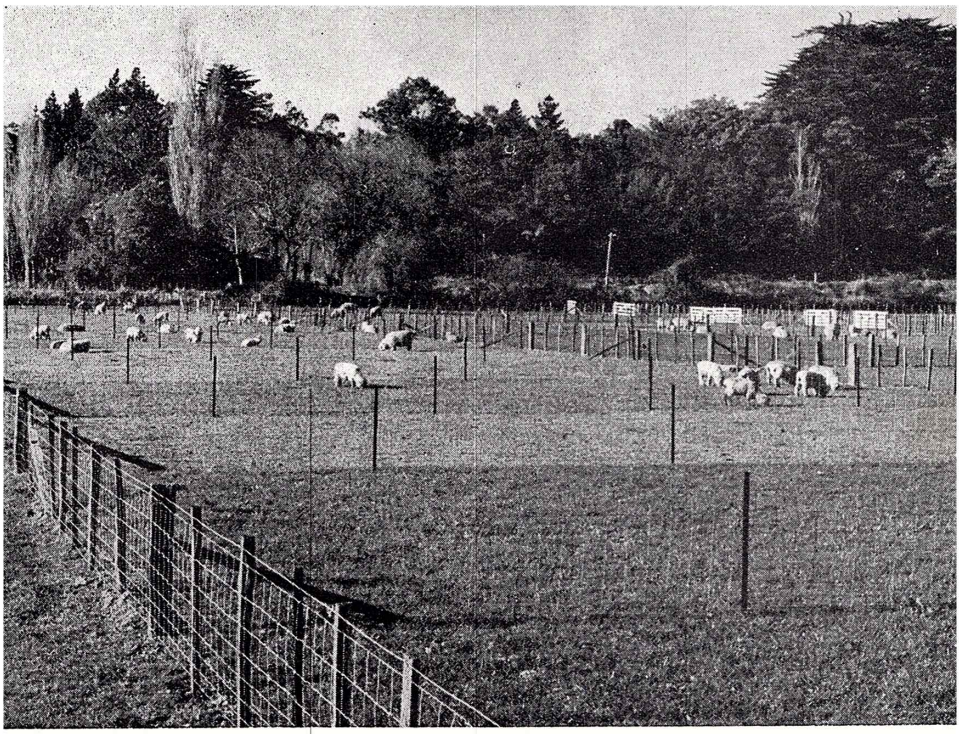

EXTENDING SEASON OF GROWTH OF PASTURE

P. C. BARCLAY*

THERE ARE MANY FACTORS that may cause a seasonal slump of pasture growth. These include insufficient water in summer, lack of warmth or light in winter, plant diseases at any season, and excessive water preventing utilization in winter. Some of these may be completely or partially alleviated by controlling the environment, provided that the cost is economic. Irrigation and drainage are examples of this. But more often than not the only practical remedy is to produce, if possible, a new variety of grass or clover. To do this, the plant breeder must either find or induce new characteristics in plants and then select to combine old and new traits in a variety satisfactory to the farmer. This paper deals chiefly with extending season of growth of pasture plants into the cooler parts of the year, will give

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some idea of the evolution of work and thinking during the last decade, and will also present some current results.

It is often true that New Zealanders consider the natural or developed products of their country to be the best in the world. Our way of life! Our scenery! Our butter! And this has been true for our pasture varieties too. Only in 1956, at the 7th International Grassland Congress held at Massey College, a prominent agricultural authority stated, in referring to pasture varieties, "No foreign ecotypes have in New Zealand come up to New Zealand ones". It was certainly true that no overseas varieties, natural or selected, approached in overall value those developed by the plant breeder largely from the best New Zealand old pastures which originated from seed sown by the early settlers. But even 10 years ago evidence was accumulating that some New Zealand pasture varieties lacked growth in the cool seasons of the year compared with introductions from overseas. A white clover from Spain had strong cool season growth at Palmerston North compared with New Zealand white clover but was much poorer than New Zealand in summer. A *Lotus major* from Portugal gave a similar comparison with New Zealand *Lotus*.

These studies indicated that New Zealand pasture plants, introduced in the early days most certainly from England or northern Europe, had originally evolved in climates in which dormancy in the winter had survival value against cold conditions. A very different type of plant appears to have evolved under Mediterranean conditions of high winter and very low summer rainfall. The only season the plants have water for growth is winter and these winters may be quite cold. Winter-growing but fairly hardy plants are therefore evolved. Thus it was realized that, although New Zealand had obtained the type of plant required for its main growing season from northern Europe, the winter dormancy of these plants was apparently preventing the use of them to full advantage in view of the considerable potential of the relatively mild New Zealand winters.

It is fairly clear today that the hybrid ryegrass breeding initiated with marked success by Dr L. Corkill at Grasslands Division was already, over 20 years ago, using plant material which by its name, "Italian" ryegrass, was of Mediterranean origin. The writer does not think that the Mediterranean implication of this programme was at all obvious at this stage.

Studies over the last decade have confirmed that introductions from the main pasture countries of the northern hemisphere — Great Britain, northern Europe, North America — are largely winter-dormant and summer-active whereas introductions from Mediterranean countries, countries in general with a very backward agriculture, are largely winter-active but poor in summer. It is the policy at Grasslands Division to obtain, in every way available, seed or plants from Mediterranean countries and to date the Division has in white clover winter-active forms from Algeria, Morocco, Israel and Spain; in *Lotus,* from Portugal; in red clover, from Morocco, Algeria and Portugal; in cocksfoot from Portugal, Spain and Algeria; and in tall fescue from Israel and Algeria. The Food and Agriculture Organization (FAO) of the United Nations has been very helpful in this respect. However, compared with Australia and Great Britain who have sent collecting expeditions throughout the Mediterranean for pasture plants, this country, which stands to gain the most, has done very little. Activities have, with few exceptions, been limited to writing requests for seed which may only become available years after collection. The potential value of Mediterranean pasture plants to the economy is already sufficiently established for New Zealand to collect in the Mediterranean on a big scale. If this is not done, then New Zealand may lag behind other countries. In addition, this great reservoir of Mediterranean pasture plant material may vanish quickly for, as agricultural practices improve in these undeveloped countries, so will the pastures change from the present amazing mixtures to a more universal and restricted sward.

The fact that all these introductions with much better cool season growth than New Zealand varieties are also poorer in summer leads to two ways of using them. First, they can be used as components in mixtures. This approach is being actively pursued in England but has not been taken up by New Zealand agronomists. The total growing season in New Zealand is so long that any variety with a restricted growth period is likely to be smothered out. Secondly, they can be used to cross with New Zealand plants to try to breed new varieties that combine, insofar as is possible, the good characteristics of both Mediterranean and New Zealand plants. This approach is being pursued actively at Grasslands Division as illustrated by the following data:

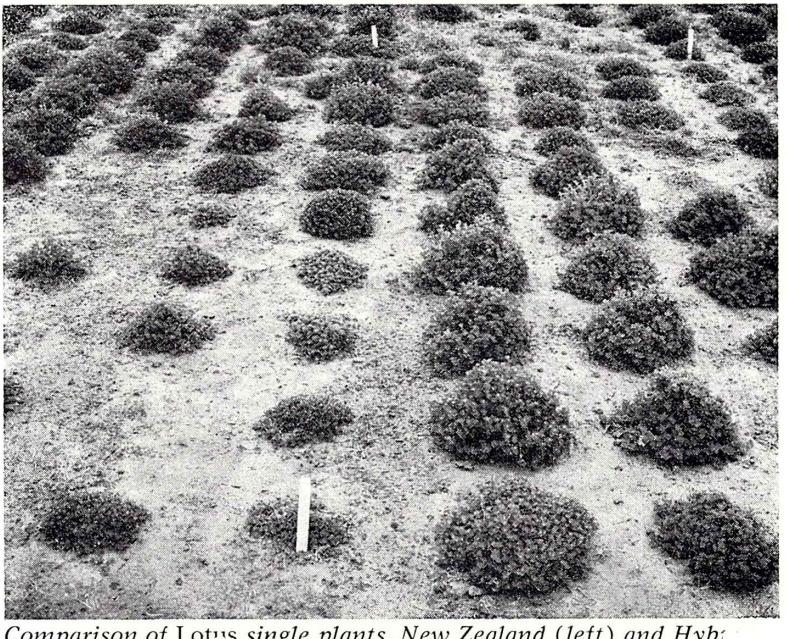
A. *Lotus pedunculatus* (syn. *L. uliginosus, L. major*):

The Portuguese winter-growing introduction was crossed with elite New Zealand plants and selected plants of the resulting F_1 hybrid backcrossed to both New Zealand and Portuguese parents. Table 1 shows a comparison of these two backcrosses with New Zealand and Portuguese for summer (January/February) and winter (July/August) production.

TABLE 1: *Lotus* Production. Single Plants. 1962

Variety	*Summer*	*Winter*
New Zealand	100	100
Hybrid 1 (N.Z. × P.) N.Z.	109	245
Hybrid 2 (N.Z. × P.) P.	90	293
Portuguese	69	373

It is clear that New Zealand has high summer and low winter production compared with Portuguese. Of the two backcross hybrids, both approach New Zealand very closely in summer but both are intermediate between Portuguese and New Zealand for winter, even the poorest (245) being twice as good as New Zealand.



Comparison of Lotus *single plants, New Zealand (left) and Hybrid (right), August, 1961.*

B. White clover:

The Spanish winter-growing introduction was crossed with elite New Zealand plants and selected plants of the resulting F_1 hybrid backcrossed to elite New Zealand plants. Table 2 shows a comparison of this backcross with two parent varieties for summer (January/February) and winter (July/August) production.

TABLE 2: White Clover Production. Single Plants. 1961

Variety	*Summer*	*Winter*
New Zealand	100	100
Hybrid	89	200
Spanish	53	275

New Zealand is about twice as good as Spanish in summer, but only about one-third as good in winter. The hybrid backcross is not as good as Spanish in winter but has twice the winter production of New Zealand. In summer the hybrid is nearly as good as New Zealand. Selection is continuing within the hybrid populations.

In white clover, leaf characteristics are markedly different between winter-dormant and winter-active forms. Table 3, supplied by G. S. Harris who is responsible for the

Comparison of white clover plots (in association with "new" hybrid" ryegrass), New Zealand (left) and Spanish (right), August, 1962.

Division's introduction programme, compares for New Zealand (winter-dormant), Spanish (winter-active) and a new Moroccan introduction (winter-active) the petiole length, petiole diameter and the mean area of trifoliate leaves at this time of the year (mid-winter).

TABLE 3: White Clover, Petiole Length, Petiole Diameter and Leaf Area. June 20, 1963

Variety	*Petiole length (mm)*	*Petiole diameter (mm)*	*Leaf area (sq. cm)*
New Zealand	95	1.5	5.3
Spanish	122	1.9	11.4
Moroccan	133	3.0	19.2

It can be seen that New Zealand is quite small-leaved and small petioled compared with Spanish and Moroccan.

C. Ryegrass:

Dr L. Corkill originally developed short-rotation ryegrass by selection within hybrid populations produced by crossing selected Italian and perennial ryegrasses. He then initiated the breeding of a "new hybrid ryegrass" developed by crossing short-rotation with perennial ryegrass and the four varieties are compared in Table 4 for winter (July/August) and summer (January/February) production.

TABLE 4: Ryegrass Production. Single Plants. 1962–63

Variety	*Winter*	*Summer*
Italian	162	17
Short-rotation	153	53
"New hybrid"	138	128
Perennial	100	100

It is clear that, for winter, only the short-rotation variety compares with Italian, but for summer the "new hybrid" is well ahead of the other varieties including perennial. This summer superiority of the "new hybrid" is associated with a marked resistance to rust and also Argentine stem weevil under conditions of medium to high soil fertility. This ryegrass programme has been the main improvement work of the Division for many years. Important though this extra growth may be, it will, however, be easily recognized that, if the winter and summer growth of the grass component of a permanent sward is improved in this fashion, some difficulties could easily arise in maintaining vigorous clover, if it too is not improved. As discussed under white clover, this improvement is under way.

D. Red Clover:

L. B. Anderson of Grasslands Division staff has a most promising programme in red clover. Some years ago he

found that a Moroccan introduction obtained through FAO had strong winter-growth when compared with cowgrass or Montgomery red clover. In summer the situation was reversed, the Moroccan being poor and the cowgrass and Montgomery vigorous. Crosses between cowgrass and Moroccan have produced a first generation hybrid of good type that grows earlier in the spring than cowgrass and later in the autumn than either cowgrass or Montgomery. At present these hybrids can be seen in full growth while cowgrass and Montgomery have become dormant, and Moroccan is only just commencing growth.

In conclusion, it seems reasonable to expect that new varieties of pasture plants produced by crossing appropriate Mediterranean and New Zealand varieties will help to extend seasonal growth, particularly in the cooler parts of the year. Slump periods may be alleviated and a better balance of grass and clover maintained.

DISCUSSION

Q:: *Can the new Mediterranean clovers be oversown on hill country? Would they be able to compete with existing species when oversown?*

A:: It is not suggested that clovers introduced from the Mediterranean are suitable for use as such. We are attempting to incorporate certain good features of Mediterranean types into New Zealand varieties. We hope the resulting new hybrid varieties will more than hold their own in competition because of greater seasonal spread of production. Establishment of these clovers by oversowing will be as difficult as with the present clovers unless competition is reduced by methods such as chemical ploughing.

Q:: *When will the new clovers and hybrid ryegrass be available to farmers?*

A:: The "new hybrid" ryegrass should be available in about three years. It is too soon to give a time for any new clover varieties that may be released.

Q:: *Has any work been done on the palatability of the various clover types to stock and has any study been made of the thrift of stock eating these clovers?*

A:: In white clover no differences have been detected in palatability between Spanish, New Zealand and their hybrids. Studies of thrift of stock eating new varieties are made before release.

Q:: *Have you measured the nitrogen-fixing capacities of the Mediterranean clovers?*

A:: Yes. The Spanish introduction was capable of fixing nitrogen under cool season conditions when New Zealand white clover fixed little.

Q:: *In view of the differences in summer and winter growth of these Mediterranean clovers would you suggest that farmers when using them should have two types of special-purpose pastures—one for the winter and the other for the summer?*

A:: No. The proposition in this paper is to breed hybrid varieties with both winter and summer growth.

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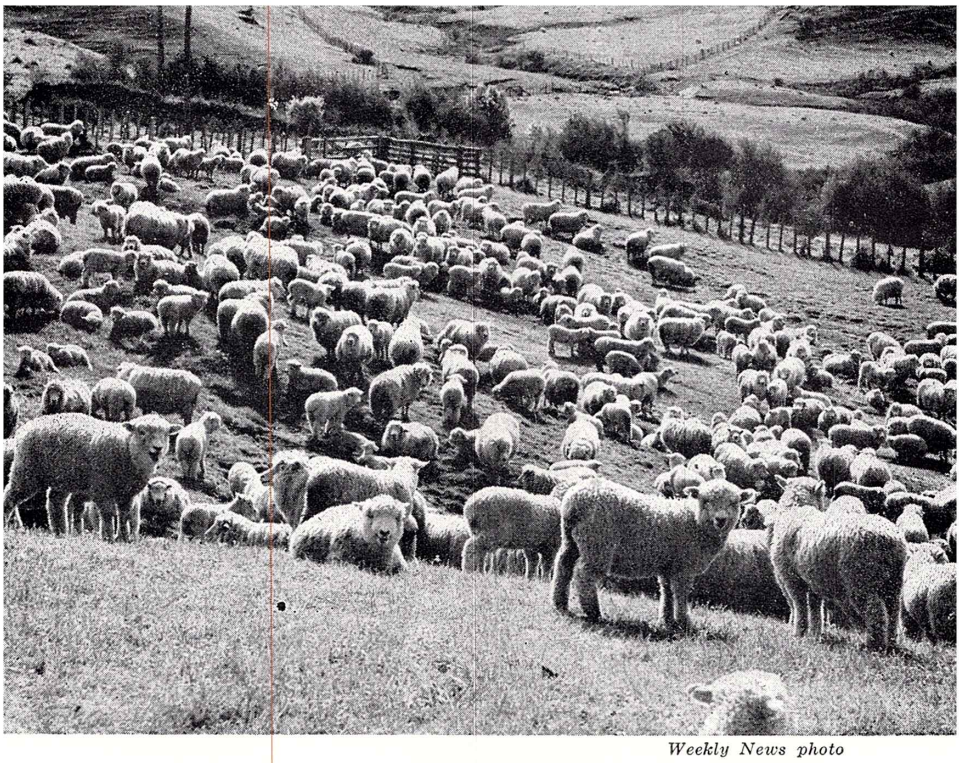

Weekly News photo

INVESTIGATIONS INTO FACTORS AFFECTING FLOCK FERTILITY

T. D. QUINLIVAN*

THE ROMNEY MARSH SURVEY was initiated as the result of consultation between the Meat and Wool Boards and the Romney Marsh Breeders' Association, these three organizations being the contributing bodies. The aims of the unit are threefold, first, to examine the production potential of the breed within studs and flocks, secondly, to pinpoint productive weaknesses that undeniably exist in any animal population, and thirdly, to make recommendations to the appropriate organizations so that more constructive intensive research can be undertaken either by these bodies or by the survey as a research unit. It will be realized by events that have happened in the past and by a practical consideration of what is reported here that these observations are of dire national farming importance.

The lambing percentages in the major sheep-raising districts of the North Island have steadily decreased over the

* *N.Z. Romney Marsh Survey, Feilding.*

last twenty to thirty years. Rather than point the bone at those who might be considered responsible for this state of affairs, some deliberation is desirable. The call is for greater production per acre. Pasture and grazing management has noticeably made tremendous advancement. It would be hard to claim a corresponding advancement in the field of animal breeding and production.

The following observations should give further food for thought. Figure 1 gives a synopsis and tabulated form of the type of progression that exists in the fertility cycle of the ewe, placing prime emphasis on recognized forms of wastage.

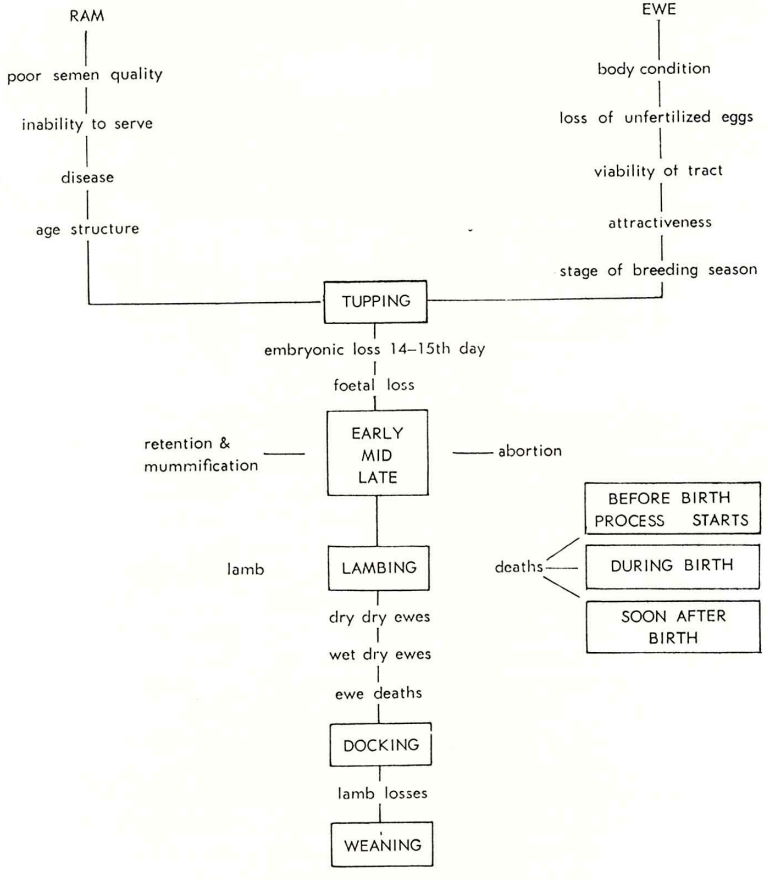

FIG. 1: *Fertility cycle of the ewe.*

POOR SEMEN QUALITY

The Survey has semen-tested a total of some 400 rams of all ages over the last 18 months and graded them on a motility score, the percentage of abnormal forms and the ratio of live to dead sperm. Subsequently his performance is recorded during tupping and it has been found from these observations that there is a distinct correlation between semen quality and subsequent performance. This has proved a valuable survey tool. It has been substantiated that a ram can have four possibilities as regards fertility:

(1) He can be fertile as shown by A in Table 1.

(2) He can be infertile in his first 17 days of tupping and subsequently improve as shown by B in Table 1.

TABLE 1: Ram Recording Form

Ram No.	*Ewes To Ram*	*Cycle*	*Covered*	*% Covered*	*Conceived*	*% Conceived*	*Returns*	*% Returns*	*Uncovered*
		I	70	70	63	RP—90 EP—63	7	10	30
A	100	II	25	25	30	RP—94 EP—30	2	6	5
		III	3	3	4	RP—80 EP— 4	1	17	2
		I	70	70	30	RP—43 EP—30	40	57	30
B	100	II	25	25	55	RP—85 EP—55	10	15	5
		III	3	3	12	RP—92 EP—12	1	8	2
		I	70	70	50	RP—71 EP—50	20	29	30
C	100	II	25	25	20	RP—44 EP—20	25	56	5
		III	3	3	24	RP—86 EP—24	4	14	2
		I	70	70	15	RP—21 EP—15	55	79	30
D	100	II	25	25	15	RP—19 EP—15	65	81	5
		III	3	3	2	RP— 3 EP— 2	66	97	2

(3) He can show sporadic rises and falls in fertility throughout his tupping — this can sometimes be related to cold snaps in the weather, when the percentage of abnormal forms rises as shown by C in Table 1.

(4) He may be infertile as shown by D in Table 1.

Table 1 shows all four of these possibilities on the tupping performance sheets the Survey uses.

Most of the figures are self-explanatory. The breeding cycle is divided into three equal 17-day periods. The E.P. percentage is the ewe performance figure expressed as a percentage of the ewes conceived over the total ewes to the ram. The R.P. percentage is expressed as the percentage of ewes conceived to those covered. It has been found that 1 in 5, or 20% of rams are below 50% in efficiency in all three cycles. Considering the figures of W. M. Webster, late of the Veterinary Department of Massey College, who did a tremendous amount of work with ram testing — and who stated in the *Sheepfarming Annual* of 1939 that 13% of rams were below par as regards fertility — the trend is an ominous one.

Greater attention must be paid to ewes and rams during tupping. In fact the writer is firmly convinced that as much time should be spent with ewes during tupping as at lambing. It can be seen that the faulty ram could be an important source of the dry dry ewe. The Survey has produced a practical chart (Table 2) for the use of studs to record tupping data and this has been welcomed by breeders as a practical approach to obviate the inevitable mistakes that can be made.

TABLE 2: Record Chart for Tupping

Ram No.	*No. of Ewes*	*Coloured*	*Date*
		1st Service	
		1st Return	
		2nd Return	
		1st Service	
		1st Return	
		2nd Return	

All rams have to be raddled or harnessed and the top line concerns only those sheep that will be covered by the ram for the first time, irrespective of colour used. Each day or every other day, counts are made of the ewes and the figures recorded are cumulative. The second line involves the returns which would start at the beginning of

the second cycle (at the end of the first 17 days). The third line concerns those ewes that return a second time, the recording of these to start at the beginning of the third cycle. This chart is conveniently placed in the wool shed, and at any time the overall picture on a per ram basis can be seen.

Knowing the amount of detail that involves mating in studs, one often wonders how the ordinary flock man manages to get any ewes in lamb at all.

ADDITIONAL FACTORS AFFECTING RAM PERFORMANCE

Inability to Serve

Some rams exhibit this phenomenon: the urge to serve is absent, whether it be physical or psychological. Injuries, etc., should be obvious but the choosy server that, for instance, serves only woolly ewes and not shorn two-tooth ewes seems to be quite common.

Disease

Most farmers are aware that disease has a profound effect on fertility but how often are rams checked before and during tupping? Epididymitis and allied conditions of the testicle have received much publicity. Scrotal mange, feet conditions, pizzle rot, any systemic disease such as pneumonia, all have catastrophic effects on semen quality.

Age Structure

It is the considered opinion of many observers including members of the Survey that aberrations of ram fertility occur mainly in younger and older sheep. The age structure in studs anyway shows a high proportion of two-tooth rams and this could well account for the high percentage of below par fertility rams. Shifting of sheep from one district to another often brings about lapses of fertility, mainly through changes in nutrition and/or environment.

Nutrition of Rams

Overseas trials involving concentrate feeding versus grass feeding prior to tupping show little difference in subsequent fertility. Seminal volume may increase slightly but that is the only change. In fact it has been reported that feeding rams on a high protein ration commonly leads to a rise in the number of abnormal forms in the semen. Some concentrates, of course, are lethal to semen quality — it has been shown in work that the Survey was undertaking prior to tupping the drastic effect on semen quality of

feeding red clover and lucerne, for instance. On withdrawal from these feeds, fertility improved. This substantiates work under way in Australia at the moment.

Ewe Effect

This side of the fertility story can be aply called "the unknown", but with the advent of more accurate techniques of egg isolation, embryo recovery in the early stages of pregnancy, and perhaps a more lucid approach towards the cause of death in lambs before the birth process commences, rapid strides should be made.

BODY CONDITION

Work at Lincoln showing that the optimum weight in two-tooths pre-tupping should be 100 lb body weight to attain high lambing percentages and recent work at Ruakura emphasizing the effect of body weight pre-tupping, flushing and its association with high lambing percentages prompted the Survey to examine the situation in two-tooth ewes on studs. The following observations were made:

(1) The average body weight of 2,500 two-tooth ewes pre-tupping was 113 lb, the range being from the heaviest at 151 lb to the lowest at 72 lb. 15.8% of all ewes weighed were under 100 lb in comparison with flock properties where 90% of two-tooth ewes are under 100 lb body weight.

(2) Face cover, body weight, fertility comparisons were made over 2,000 two-tooth ewes pre-tupping. Table 3 shows the results of these observations.

TABLE 3: Face Cover in Two-tooth Ewes on Studs and Flock Properties

BODY WEIGHT PRE-TUPPING

	*Face Cover Grade**		
	1	*2*	*3*
Stud sheep	117.5 lb	112.3 lb	110.1 lb
Flock sheep (Ashburton)	119.0 lb	115.2 lb	114.3 lb

FERTILITY

	*Face Cover Grade**		
	1	*2*	*3*
Stud sheep:			
Lambing %	104	98	96
Total dry ewes (%)	16	13	12
Flock sheep (Ashburton):			
Lambing %	112	102	100
Total dry ewes (%)	11	12	13

* 1 = open faced; 2 = medium face cover; 3 = woolly faced.

As can be seen from these figures, a difference does exist between the various grades of face cover. Whether this is tility, no doubt will remain an unanswered question because of blood line, district, age, state of nutrition and rate of fertility selection differences. The general trend in the Romney studs today is away from the muffled face because of the demand from the buyers; from the above observations out of the 2,000 ewes examined the fact that 63.4% of ewes fell under Grade 2 substantiates this point.

(3) Observations were made with some 650 two-tooth ewes prior to tupping by weighing at weekly intervals, noting the changes in body weight and the subsequent lambing percentages. On supposedly flushing pasture most lost weight. Those that were on the increase immediately prior to tupping gave the best lambing results, as shown in Fig. 2.

In the first case, where the ewes had increased in body weight by 10.3 lb in the four weeks pre-tupping, the lambing percentage was 124.5, the percentage of ewes rearing twins was 47, the dry dry ewe percentage was 4 and the wet dry figure 8.2; in comparison with the second property

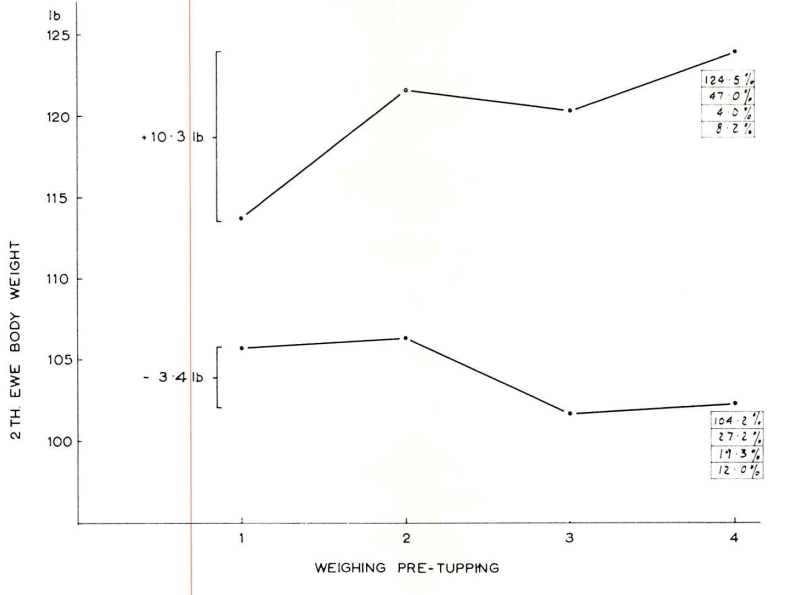

FIG. 2: *The effect of variation in body weight pre-tupping and subsequent fertility.*

where the ewes lost 3.4 lb pre-tupping, the subsequent lambing percentage was 104.2, the twinning 27.2, the dry dry ewe percentage 19.3, and the wet dry 12. These results substantiate Coop's work at Lincoln completed recently.

From these observations it can be seen that body weight has a pronounced effect on ewe fertility, particularly in the two-tooth ewe pre-tupping.

FURTHER TUPPING OBSERVATIONS ON EWES

The Use of Teasers

Apart from collecting routine data over tupping, recording the number of ewes covered, conceived, returns and not covered by the ram on a sire basis in an attempt to correlate the semen data already collected, it was interesting to note the effect of teasers in flocks where they were used pre-tupping. Of 2,787 ewes where teasers were used, 77.6% were covered by the end of the first cycle of 17 days in comparison with 5,097 ewes where teasers were not used, where only 47.1% were covered in a comparable period. A discussion on the merits or otherwise and the applied use of teasers is beyond the scope of this paper. One word of warning — if it is contemplated using teasers, the farmer should make sure he gets them done well before tupping or he may end up with ewes in lamb by an unknown sire and lambing starts earlier than anticipated.

Intensive Flock Investigation

To elucidate still further the patterns of ovulation loss, embryo loss and foetal loss in the early stages of pregnancy, the Romney Marsh Survey has initiated a series of intensive slaughter experiments. In the last three months the unit, with the co-operation of M. F. McDonald of Massey University College, has been undertaking an investigation involving the slaughter of 208 four-tooth stud Romney ewes, all of which were obtained from 52 Romney breeders in the southern half of the North Island. Half of these were dry and the other half wet as two-tooths the previous year. The design of this work was as follows:

(1) One-third of the ewes were slaughtered two days after being tupped to ascertain the loss in eggs not being fertilized.

(2) One-third were slaughtered at the 18-day stage after tupping to assess the proportion of embryos either alive or dead.

(3) One-third were slaughtered 30 days after tupping to assess the loss of foetuses between the 18th and the 30th days.

Unfortunately the results of this experiment are not known yet but comparisons will be drawn between the wet and dry ewes on the basis of twinning potential through the histories given, body weight variation before and during tupping, and so on. Exceedingly valuable information can be obtained from such work and it is anticipated that this work will be continued in the future.

The main object of this type of work is, of course, to gain a greater appreciation of the stages of loss throughout pregnancy, from the day the ram goes out till weaning. Work overseas suggests that such a loss could be of the order of 70%, but the most important point to be elucidated is to recognize at what stage the loss occurs and then the reason for such a loss. The fertility of the Romney ewe under New Zealand conditions desperately needs defining and the Survey as a unit with such resources as co-operative breeders and ample sheep with good histories behind it has a golden opportunity to define the problem not only under North Island conditions but also in the South Island and eventually on a Dominion basis.

ABORTION

An all-out attempt was made last year prior to lambing to investigate the cases of abortion in studs both inside and outside the Survey. In all cases *Vibrio fetus* was isolated, and from reports from Hawke's Bay and the Wairarapa it was gauged that it was rampant throughout the southern half of the North Island at least. All abortions were examined bacteriologically and 7 out of the 15 Survey studs produced a positive diagnosis, the variation of abortion rate being 0.8% to 5.8% of the total ewe flock. Observations show that abortion started in the last 3 to 4 weeks of pregnancy, and in the high incidence flocks where, say, 5.8% of the ewes aborted, the pattern was a classical one. Initially abortion was the first clinical evidence of the condition and when lambing started there was a high proportion of dead lambs, progressing later to the birth of weakly lambs that died soon after birth, and then small lambs that survived, and finally all evidence of the disease petered out and lambing continued as normal. Table 4 shows the progression pattern that seems to exist with vibriosis.

TABLE 4: Abortions due to *Vibrio fetus*

Cycle in which ewes were tupped	1	2	3	4
Percentage of total abortions	59.2	21.1	10.5	2.6

It is obvious that the most susceptible group were the early lambers. After that flock immunity rose and the abortion rate tapered off. It can be assumed that flock immunity will persist for three to four years and, if the organism is present after this immunity has waned, abortion may occur again. A vaccine against this disease is under trial at the moment and, if successful, should be a valuable preventive in the future. In an outbreak, streptomycin as an injection could be used for all in-contact animals in an endeavour to halt the course of the disease in valuable stud stock. Price may prohibit its use otherwise.

The manifestations of vibriosis were evident in a perinatal lamb survey done by the unit during lambing, shown by a high degree of mummified foetuses presented — these constituted 20% of all lambs that were considered to have died before the birth process actually started.

LAMB LOSSES

A perinatal lamb death survey was done by the unit during the lambing of 1962 and observations will continue this year to ascertain the main times and causes of death, this ultimately leading to more intensive work on practical methods of prevention. Table 5 shows the results of this work.

TABLE 5: Relationship of Lamb Deaths to Time of Death and More Important Causes of Death

Time of Death		*Cause of Death*	
Before birth process starts	18.5%	Vibriosis	34%
		Toxoplasmosis	29%
		Congenital	4%
During birth process	53.8%	Dystocia	82%
		Vibriosis	5.8%
		Congenital	4.8%
After birth process	27.7%	Dystocia	8.4%
		Vibriosis	2.5%
		Navel infection	16.9%
		Pulpy kidney	10.2%
		Pneumonia	11%

Dystocia or difficult birth obviously is the prime cause of death. Considerable speculation has been given to the predisposing factors and from observations made overseas and in this country they can be considered as follows:

(1) Nutrition of the ewe in the latter third of pregnancy directly affects the size of the foetus. The higher the plane of nutrition the greater the size of the lamb. This is considered to be the major factor involved in difficult birth. Preventive measures, including the gradual depression of food intake post-tupping till about 4 to 5 weeks prior to lambing, would help to control this. The prevention of pregnancy toxaemia is the problem, but urine tests for this condition are available, this affording an early recognition of cases followed by remedial steps. A proportion of ewes in any one flock can act as markers — these, if possible, should include ewes that have had the condition the previous year and recovered, or ewes that are prone to show early symptoms every year.

(2) Pelvic dimension no doubt contributes in part to the condition. A proportion of sheep have V-shaped pelvises, in some the backbone is depressed, and in others the tuberosity on the pelvis is very prominent. All these lead to a smaller passage for the lamb to pass through. Work in this country points out the correlation between the length of the cannon bone in sheep and pelvic dimension. This is an interesting possibility and evidence suggests the hereditary nature of pelvic malformation.

(3) Irrespective of what the malpresentation may be, prolonged birth invariably results.

(4) Poor shepherding.

DRY EWES

Considerable stress has been laid upon the dry ewe in flocks where the lambing percentages are low. As can be seen, this is only one of the factors to be taken into consideration. Recently the Romney Marsh Survey completed a survey in the southern part of the North Island over 140,000 flock sheep, these property owners constituting 20% of the ram clients of the Survey studs. Table 6 shows the results of this survey on a district basis, and Table 7 on a flock number basis.

The average lambing percentage is 95, the dry dry ewe average is 5%, the wet dry ewe average over 60% greater at

TABLE 6: Lambing Percentages on a District Basis

District	*No. of Ewes*	*Lambing %*	*Dry Dry Ewe %*	*Wet Dry Ewe %*	*Total Dry Ewe %*
Taihape/Raetihi	7,741	92.5	5.5	7.1	12.6
Nth. Manawatu	10,081	98.9	3.9	9.7	13.6
Feilding/Marton	9,663	101.0	8.9	9.2	18.1
Central Hawke's Bay	8,396	88.9	5.8	12.1	17.9
Southern Hawke's Bay	16,760	96.3	5.9	5.5	11.4
Gisborne/Rotorua	9,617	92.4	4.8	11.9	16.7
East Coast coastal country	39,900	88.9	6.3	8.2	14.5
North Wairarapa	9,403	102.6	3.1	7.5	10.6
Masterton	9,431	87.4	4.8	12.0	16.8
South Wairarapa	8,927	101.3	2.4	10.3	12.7

TABLE 7: Lambing Percentages on a Ewe Flock Size Basis

Flock Size	*Lambing* %	*Dry Dry Ewe* %	*Wet Dry Ewe* %	*Total Dry Ewe* %
4,000	94.2	5.0	9.2	14.2
3 - 4,000	86.7	6.2	11.5	17.7
2 - 3,000	90.9	4.6	8.4	13.0
1 - 2,000	95.4	5.1	7.8	12.9
1,000	96.8	5.5	7.4	12.9

8.1%, making the total dry ewe figure 13.1%. Therefore the wet dry is obviously the major contributing factor in the dry ewe problem in flocks.

The following points have come out of this survey:

(1) On a district basis there is a variation in lambing percentage.

(2) On a flock number basis there is little variation. The higher the ewe flock number the higher the total dry ewes. This is to be expected but on a proportionate basis, comparing larger with smaller flocks, the lambing percentage, etc., are good for the high ewe numbers. It is evident by examining these figures that any problem in lowered lambing percentages is of a general nature except in cases where obviously management through poor animal husbandry is a contributing factor.

(3) As the two-tooth ewe numbers increase, so the lambing percentage decreases and the total number of dry ewes increases. The following figures substantiate this point: Where the two-tooth ewe numbers constitute one-fifth of the flock, the lambing percentage is 97.3; where the two-tooth ewe numbers constitute two-fifths of the flock, the lambing percentage decreases to 89.2.

(4) There is no evidence to suggest that the later the rams are put out the better the subsequent lambing percentage. In fact in those cases where the rams were put out after April 1, the lambing percentages dropped markedly and there was an increase both in the dry dry and the wet dry ewes. The optimum period seems to be about March 25 for southern North Island conditions.

(5) The lengths of the mating period vary from 52 to 125 days; the longer the periods of mating, the better the results as regards lambing percentage. It is pointed out in recent Ruakura work that, if the rams are left out for a period greater than 80 days, the lambing percentage tends only to increase by 1. Associated with this prolonged tupping is the fact that, when tupping and subsequently lambing is dragged out over an extended period, the farmer is faced with nursing cull hoggets through the winter. It looks as though 80 days' tupping is optimal.

(6) Ewe and lamb losses. The overall picture of ewe deaths appears to be relatively constant in all districts. It was obvious from results obtained that where ewes were not vaccinated losses were high, and the general overall ewe loss over the whole Survey was 4.34% — although serious it was not excessive. Between docking and weaning, 2.1% of lambs are lost, and figures show that vaccination reduced lamb losses by 16% between unvaccinated and vaccinated properties.

Conclusion

As can be seen, the problem is a complex one with many variables. Productive improvement on a flock basis poses a difficult problem because of size of flock, the difficult country many flocks are run on, long established management practices and labour, but through the policy of, first, elucidation to define the problem accurately and, secondly, correcting it by bringing to the notice of farmers sound factual information on selection for greater fertility, sub-

sequent improvement should be forthcoming. As a start to this approach, a district has been selected in the southern North Island through the formation of a committee to look into ways and means of raising lambing percentages on hill country. It is intended to examine the following five factors:

(1) The two-tooth ewe situation.
(2) The ram situation.
(3) The dry dry ewe.
(4) The wet dry ewe.
(5) The twinning potential.

The selection of any of these five factors would increase lambing percentages. This is felt to be a practical approach to the data collected. It is hoped that further such committees will be up set in other districts to pursue similar lines.

It will be a long job and much will depend on the co-operation of the stud and the flock man to do better than he is already doing. If that desire is not there, then both time and money are being wasted.

DISCUSSION

Q:: *How do you reconcile your results with differences in ovulation rates that other workers have found as the breeding season progresses?*

A:: As pointed out in my paper, the results of this experiment are not known yet. You will remember that this work was designed to give an insight into loss in the early stages of pregnancy and the ewes were slaughtered after first service. The only indication of rate of ovulation differences in progressive heats will be shown in those ewes that actually returned to first service and because these numbers were low the figures probably will not be significant.

Q:: *Are not 17-day colour changes for the tupping harness technique too long for some of the ewes?*

A:: No. Observations showed in the experiment mentioned that the ewes that did return did so between 15 and 18 days, the mean being 17 days. Therefore, it would seem that a colour change about the 16th or 17th day is the best approach.

Q:: *Does a saving of 16% in lamb deaths mean a saving of 16 lambs for every 100 lambs born?*

A:: Total lamb deaths between docking and weaning on flock properties were 2.1%. Of the farms involved, 55% of them had carried out vaccination at docking, and 955 (42%) of the 2,285 lamb deaths recorded occurred in these vaccinated flocks. Lambs lost on unvaccinated properties totalled 1,330 or 58% of the total lamb deaths — a difference of 16%.

Q:: *Can a ram's semen quality be easily and usefully used to predict his fertility throughout mating?*

A:: Two or three examinations are essential, the first examination preferably being done 10 days before and the second examination

5 days before tupping. In those rams giving a good semen sample, the predictability of the test is in the vicinity of 95% accurate. For those that give a doubtful or poor test, it is absolutely essential to repeat the examination — this applies more particularly to 2-year and 5-year rams. Evidence suggests that the abnormal forms in semen samples fluctuate and, as I have mentioned, in poor and doubtful quality samples with high abnormal counts the shift is to improvement on second test.

Q:: *Could the effect of condition in the two-tooth ewe and its relationship with subsequent lambing performance be a reflection of the age of the ewe, as well as of the nutritional conditions to which she has been subjected?*

A:: Age seems to have little bearing on our results and would probably count for little seeing that the middle drop of lambs seem to be the ones that thrive over their earlier and later mates. Included in the middle drop, of course, are the bulk of lambs. Age would have a bearing in a prolonged tupping, say of 120 days, so giving a higher proportion of late lambs and hence tail-end hoggets.

Q:: *Is there any advantage to be gained in selecting twin-born animals, for both hogget and ram replacements?*

A:: Yes. The percentage of ewes rearing twins, a factor that is inversely related with the percentage of dry dry ewes in a flock, is a factor that in many cases determines high or low lambing percentage. The selection for twinning both on the ewe and ram side would therefore be an integral part in raising lambing percentage in any one flock, all other things being equal.

Q:: *Is the relationship between body weight and subsequent fertility as important in the older ewe as it is in the two-tooth?*

A:: Dr Wallace's work at Ruakura suggests that this is so. This, of course, is disregarding the heavy body weight ewe that is either a wet dry or a dry dry, her heavy condition primarily being due to her inability to lamb successfully.

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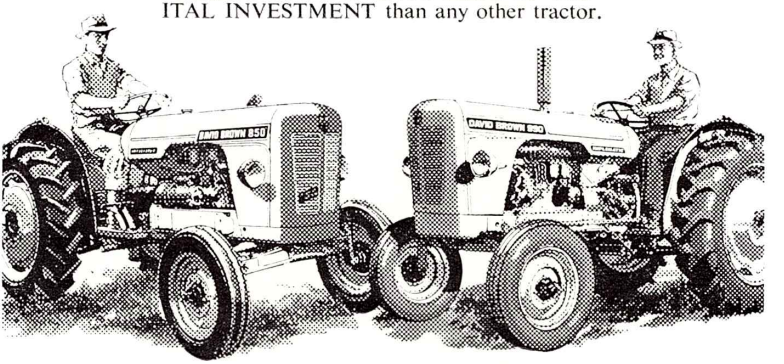

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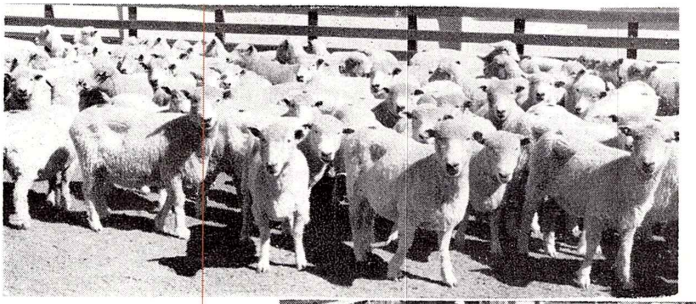
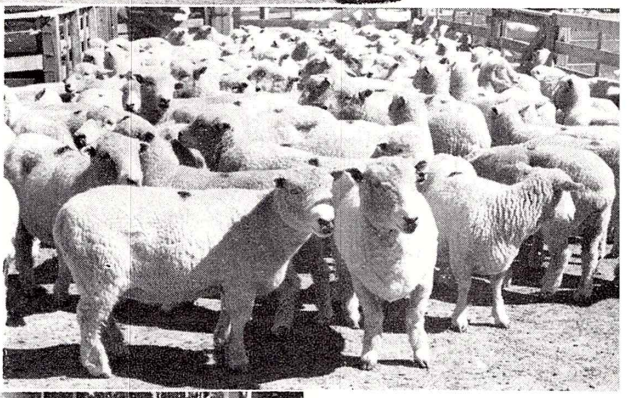
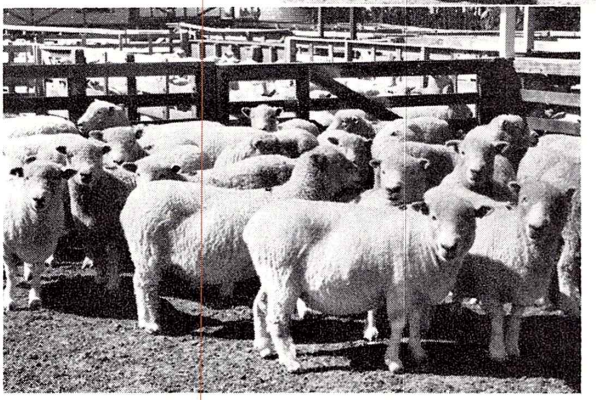


LOW PLANE



MEDIUM PLANE

HIGH PLANE



NUTRITION AND FERTILITY

L. R. WALLACE*

THE TITLE of this paper, "Nutrition and Fertility", is a very broad one and perhaps somewhat misleading, for no attempt to review all the information at present available on this topic will be made, but rather attention concentrated on one important aspect of it.

On most sheep farms in the North Island of New Zealand very little or no cropping is practised and pasture provides virtually the sole diet for sheep. Normally there is tremendous seasonal variation in the volume of pasture produced, and the only way that the farmer can control the nutrition

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of his animals is through the methods of pasture and grazing management that he employs. Provided a farm is reasonably well subdivided, a great deal can be done by skilled grazing management to even out fluctuations in the feed supply and ensure that adequate feed is made available during the most critically important periods.

Obviously, if optimum fertility is to be obtained from a flock, it is essential to have detailed information, not only of the way in which the level of feeding early in life affects subsequent lambing percentages, but also of the way in which adult sheep can be expected to respond to different levels of feeding at different times of the year. With grazing animals, the quantities of feed eaten are not easily measured. However, the changes in liveweight of the animals are readily determined, and probably form the best and most convenient measure of the plane of nutrition. There is clearly a very real need to establish, both for the rearing phase and for different times of the year throughout the breeding life of the flock, the average liveweight growth curves which, if followed, will give optimum fertility.

A considerable amount of work has already been done at the Ruakura and Whatawhata Research Stations to obtain just this type of information. Naturally, in the early studies, attention was concentrated on those periods thought likely to be of most critical importance. Thus, at the Whatawhata Hill Country Station, E. A. Clarke has carried out numerous rearing studies. He has found that hoggets which are well reared during the winter not only have a lower death-rate than poorly reared ones; they also have a higher lambing percentage as two-tooths. Well-reared hoggets which at the end of winter weighed about 15 lb more than their poorly reared mates not only produced more wool but had a lambing percentage 12 to 15% higher. This, of course, emphasizes that attempts to improve lambing percentages of a flock must begin with the raising of replacements. Similarly, at Ruakura the flushing of ewes was thoroughly investigated, and the effect of subjecting ewes to different levels of feeding during the last few weeks before lambing was carefully studied. The results of these and other studies have already been published in previous volumes of the *Sheepfarming Annual* and provide the necessary information on which to base sound grazing management practices at these times of the year.

It is not intended to review here the results of all these earlier experiments but to describe the results obtained at Ruakura in more recent studies that were designed to

obtain information on the way that ewes respond to different levels of feeding imposed at a time of the year which has in the past commonly been regarded as of much less critical importance. This is the two or three months after weaning in December or early January until, perhaps, about mid-February, when an attempt is made to start flushing the ewes in preparation for mating during March. Traditionally, this post-weaning period has been regarded as the "cheap feed" period, a time when the ewes need not be particularly well fed, when they can be grazed together as one mob and used to clean out paddocks containing rough feed, and when they are often deliberately grazed very hard indeed with a view to conserving the best of the feed available for such purposes as fattening cattle and finishing the lambs remaining on the property.

At the time of weaning in December or January, ewes on fat lamb farms are often in high condition, and among farmers the view is quite widely held that those which are to be retained for further breeding should not be allowed to put on more condition and become overfat. It is not surprising that this should be the common view, for it has often been stated that fatness is a cause of infertility. For instance, in the British Ministry of Agriculture and Fisheries *Bulletin No. 39*, dealing with the subject of fertility in animal breeding, the following statement appears:

> "On the other hand, a condition of adiposity is a very common cause of infertility. Very fat animals do not come in season in a very marked way, and when they do the periods are apt to be irregular and likely to be missed, or the animals may fail to breed together." At the same time, the authors of this same bulletin issue a warning against overdoing the "cheap feed" time between weaning and tupping, and say, "If the ewes are kept in too poor a condition, there is a chance that an undue number of follicles with their contained ova (*i.e.*, eggs) will undergo degeneration at this time, and that the fertility will be reduced, notwithstanding the increased feeding preparatory to flushing."

It is fair to say that the generally accepted view has been that the condition most conducive to high fertility is a good improving one before and during tupping, and that fatness or over-condition is to be avoided as tending towards sterility; and, further, that this improving condition is much more easily achieved if the animals are not in too high condition when flushing is begun.

There is certainly abundant evidence in the scientific literature to show that where ewes are in store condition

very substantial increases in lambing percentages can be obtained by providing them with an improved level of feeding both during the two or three weeks before the rams are put out and during the first few weeks of the mating period, and results obtained at Ruakura lend full support to this. On the other hand, there is no evidence known to the writer to support the view that higher lambing percentages will be obtained from ewes deliberately prevented from becoming fat or reduced in condition before flushing than from ewes well fed from weaning right through until mating. The question is obviously quite an important one to New Zealand sheep men, many of whom do not like to see their ewes becoming too fat after weaning and often take considerable trouble to prevent this.

Evidence which has been accumulating over a number of years at Ruakura has led to serious doubts of the wisdom of deliberately attempting to take the condition off fat ewes after weaning by subjecting them to partial starvation. For the last 15 years a flock of mixed-age Romney ewes which has been maintained on the Station has each year been weighed in February before the introduction of the rams. The average liveweight of the flock has varied considerably from year to year, owing mainly to seasonal variation in the feed supply, but what has been most noticeable and interesting is that, in years when the ewes were in high condition and heavy at the start of mating, the subsequent lambing percentages have usually been high; whereas in years when the ewes were in poor condition and light, low lambing percentages have been obtained.

In 1959 and 1960, trials were conducted at Ruakura to obtain more definite information on the whole question of how ewes should be managed after weaning. In late December, 1958, a few days after their lambs had been weaned, a group of 360 six-year-old Romney ewes, which had been running under fat lamb conditions at Ruakura the previous season, were weighed, graded for degree of fatness, and divided into three similar groups each of 120 ewes. Thereafter one group, called the high plane, was rotationally grazed over the best pastures that could be provided. The aim was to induce the animals to gain weight as rapidly as possible, so that they became grossly fat. Over the same two months, the second group, called the medium plane, was grazed rather harder with a view to somewhat reducing the condition of the ewes. The third group, the low plane, was grazed very hard indeed with the object of getting the

ewes quite thin by mid-February. At the end of the second month, in mid-February, some three weeks before the fertile rams were turned in with the ewes, the three groups of animals were combined and thereafter they were grazed together on the best pastures that could be provided and later mated as a single flock. From early February onwards, two raddled vasectomized (teaser) rams had been run with each group of ewes to see whether the different levels of feeding had any influence on the way the ewes came into season. The teaser rams remained with the combined flock until early March, when they were replaced with fertile rams equipped with tupping harness so that a record could be obtained each morning of any ewes that had been tupped during the previous 24 hours.

One of the objectives of the trial has already been mentioned — to find out whether the different levels of feeding have any influence on the way the ewes come into season. A second objective was to discover how the different levels of feeding after weaning affect the number of eggs produced by the ewes when they come on heat during the mating period. To this end, starting from the time the fertile rams were introduced, a record was kept of the order in which the ewes came into season, and every fourth ewe from each group was killed 2 to 3 days after it had been mated. The breeding organs were recovered at slaughter. By examining the ovaries at this stage, it was possible to determine not only the number of eggs that had been produced at the time the ewe was mated 2 and 3 days before being killed, but also the number of eggs each animal released at the time she had ovulated some 16 to 17 days earlier while still running with the teaser rams.

The remainder of the ewes, 90 from each of the three original groups, were carried through the winter and lambed down together to see how the post-weaning treatments affected the lambing percentages.

The experiment was repeated during the 1959–60 season. The same number of animals was used and again essentially the same procedures were followed. In both seasons the ewes were weighed at intervals throughout the post-weaning, flushing, and mating periods. The liveweight changes are shown in Figs. 1 and 2.

The high plane ewes put on condition quite rapidly at first, but, as they became really fat, their rate of liveweight increase slowed down, and by the middle of February, when they were combined with the medium and low plane

ewes, they had reached their maximum weight. An interesting feature shown by the liveweight graphs is that, after the three groups of ewes were combined in mid-February, the excessively fat high plane animals lost weight for the first two or three weeks, whereas the medium and low plane ewes, grazing the same pastures, gained weight quite rapidly.

The first point of interest in the results obtained is that in neither year did the different feeding treatments have any substantial effect on the onset of the breeding season. All three groups started coming on heat at about the same time. The ewes of the medium and low plane groups took the ram just as soon — in fact a little earlier — as the ewes in the high plane group.

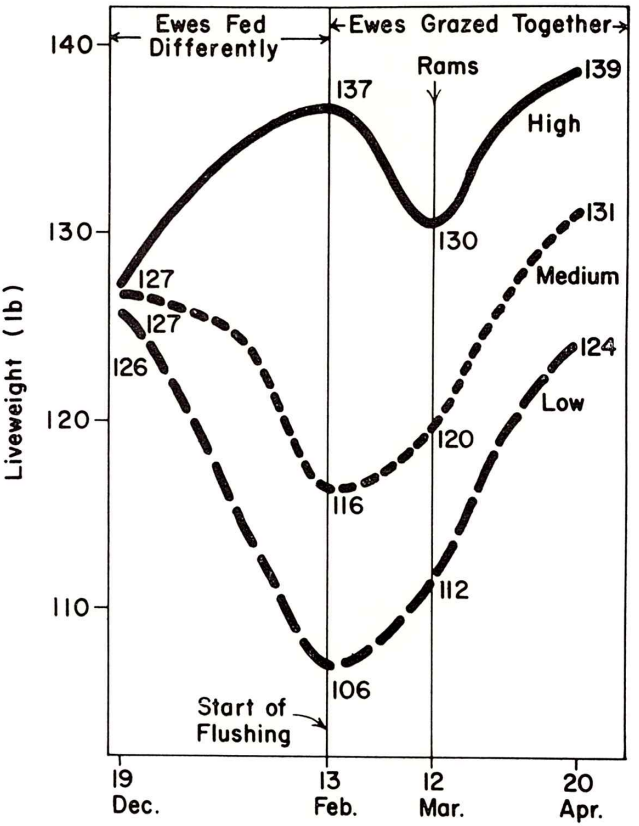


FIG. 1: *Liveweight changes, 1958–59.*

However, the different levels of nutrition to which the ewes were subjected after weaning did affect the ease with which the ewes got in lamb. Table 1 shows the percentage of ewes that lambed which became pregnant at first service. The average figures for the two years show that, whereas about 90% of the high plane animals conceived at first opportunity, only 84% of the medium plane ewes and only 80% of the low plane ewes did so. In each group the ewes which returned to service tended to be thinner than average animals. The results obtained lend absolutely no support for, and indeed contradict, the view that fat ewes are more difficult to get in lamb than thin ewes.

Table 1 shows also the number of ewes in each group which failed to lamb (dry ewes) expressed as a percentage

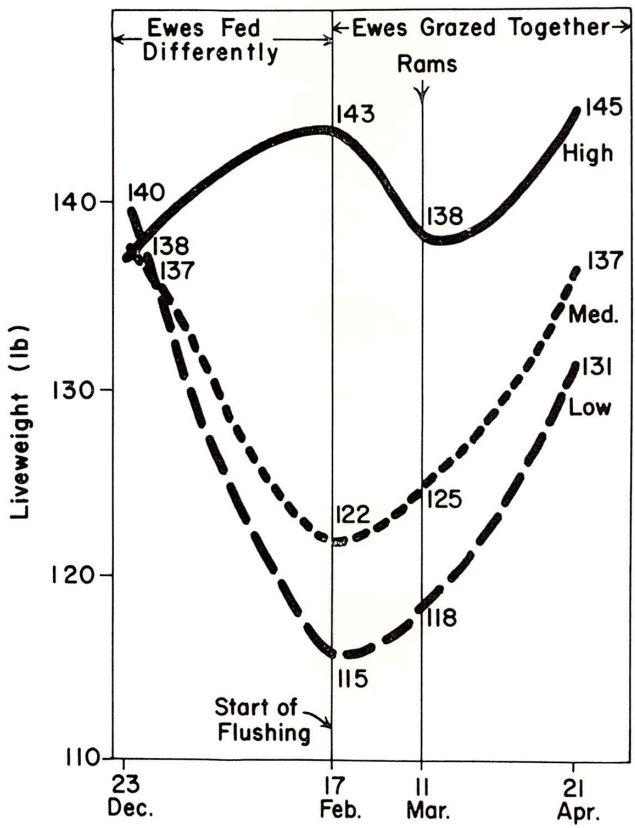


FIG. 2: *Liveweight Changes, 1959–60.*

TABLE 1: The Effect of Level of Feeding (Mid-December to Mid-February) on Reproductive Performance of Ewes (average results for two seasons)

	High Plane	*Medium Plane*	*Low Plane*
Percentage of ewes lambing	89.4	84.0	79.7
which held to first service	2.7	4.3	6.7
Percentage of dry ewes	5.5	6.5	6.1
Percentage of ewe deaths			
Average number of lambs per ewe lambing	1.51	1.34	1.35
Percentage of lamb deaths (birth to 28 days)	13.7	11.2	16.6
Lambing percentage (lambs alive at 28 days as per cent. of ewes mated)	120	107	98

of the number of ewes put to the ram. The average results for the two seasons show that there were more dry ewes in the medium and low plane groups than in the high plane group, and examination of the records of the animals which failed to conceive showed that these were mainly very thin ewes, weighing either less or not much more than 100 lb. Clearly, in these trials fatness has not caused increased infertility.

The percentage of ewes which died is shown in Table 1. Losses were somewhat variable in the two years, but on average very similar in all three groups. The small difference between groups could easily have arisen by chance.

Lambing percentages can be calculated in various ways. The most important one from the practical farmer's viewpoint is that obtained by expressing the number of lambs docked as a percentage of the number of ewes mated. This percentage is, however, an overall measure affected by three important factors:

(a) The percentage of ewes which die or fail to get in lamb,

(b) The number of lambs produced by the ewes which lamb, and

(c) The death-rate before docking among the lambs produced.

The percentages of ewes which died or failed to get in lamb have already been considered. The average number of lambs produced per ewe lambing and the death rate among the lambs born are shown in Table 1. In both seasons the high plane ewes produced more lambs than either of the other two groups. The death-rate among the lambs was on

average lowest among the medium plane ewes and highest among the low plane ewes, but this might well have been a chance effect.

The high plane ewes gave the best overall lambing percentage in both seasons. In the first year the final lambing percentage was slightly higher for the low plane ewes than for the medium plane, but in the second season the reverse obtained, and over both years the average lambing percentage was 9% higher for the medium plane than for the low plane ewes.

There can be little doubt that the superior lambing percentage of the animals that were deliberately made and kept as fat as possible after weaning was largely the result of their producing on average a greater number of eggs at the time they were mated. The average number of eggs produced by the ewes that were killed is shown in Table 2.

TABLE 2: Effect of Level of Feeding (Mid-December to Mid-February) on Average Number of Eggs Produced by Ewes that were Killed (average results for two seasons)

	High Plane	*Medium Plane*	*Low Plane*
Av. no. of eggs produced per ewe:			
During 2–3 weeks before mating started	1.67	1.46	1.32
During first 2–3 weeks of mating period	1.77	1.58	1.53

Despite the fact that high plane ewes suffered a check when they were combined with medium and low plane ewes in mid-February, their average rate of ovulation was quite high (1.67) during the three weeks before the fertile rams were introduced, and it increased still further (to 1.77) during the next 16 to 17 days. On the other hand, during the fortnight before the fertile rams were introduced, the average ovulation rates of the medium and low plane ewes were much lower (1.46 and 1.32, respectively), and, although these rose very markedly after mating began (to 1.58 and 1.53, respectively), they did not rise to the high level found for the high plane animals.

The effect of the feeding treatments on wool production remains to be considered. Each year the ewes had all been shorn at the same time, shortly before the trial was started in December, and they were shorn again in December the following year. The results are shown in Table 3.

TABLE 3: Average Fleece Weights (lb)

Season	*High*	*Medium*	*Low*
1958–59	8.54	8.20	7.74
1959–60	9.71	9.27	8.61
Average	9.13	8.74	8.18

On average, the high plane ewes clipped nearly 0.4 lb more wool than the medium plane, and the medium plane between 0.5 and 0.6 lb more than the low plane ewes, so that the average difference between the high and low plane ewes amounted to almost one pound. In considering these differences, it must be remembered that the only time the ewes were differently treated was during the two months from about mid-December until mid-February. All the ewes grazed together throughout the remainder of the year.

So much for the general nature of the results obtained. It may be worth while summarizing the main findings.

(1) The different feeding regimes to which the ewes were subjected after weaning had very little effect on the time of onset of the breeding season or the speed with which the ewes took the ram.

(2) The ewes which were well fed from the time of weaning onwards and which, in consequence, became very fat before mating began, became pregnant if anything rather more readily than ewes which were at first hard grazed for two months after weaning and then flushed for three weeks before mating.

(3) There were fewer drys among the ewes well fed throughout the post-weaning period.

(4) The animals that returned to service and that failed to get in lamb were, in the main, ewes in poorer than average condition.

(5) The ewe mortality was no higher among the fat than among the thin ewes.

(6) The ewes which were fed at a high level from weaning till mating produced the greatest number of lambs per ewe lambing and gave the highest over-all lambing percentage based on the number of ewes mated.

(7) The ewes well fed throughout the post-weaning period produced more wool than did either of the other two groups.

At this stage it should be mentioned that several of the above findings are strongly supported by work recently carried out at Lincoln College. There, Professor I. L. Coop has analysed the breeding records of some 11,000 sheep which were gathered over a fifteen-year period. Each year the animals were weighed in March just before mating, and records obtained of lambing performance. It was found that, at liveweights above 90 to 100 lb, the incidence of dry ewes was relatively constant, but below this critical weight there was a marked increase in barrenness. A particularly interesting feature of the results was that, when compared at similar weights, there appeared to be little difference between two-tooth and older ewes in respect to the proportion of dry ewes. In the case of both two-tooths and older ewes, there was a very close relationship between the liveweight of the ewes at mating and the twinning rate among the ewes that lambed. On average, each extra 10 lb of liveweight was accompanied by a 6% increase in the percentage of ewes that produced twins. These results thus emphasize the importance of having ewes well grown and in good condition at the time of mating.

A particularly interesting experiment was conducted by Professor Coop at Lincoln College last year. In mid-December about 720 ewes were weighed and divided into two groups. One of these was fed so as to lose weight until February 27, whereas the other was managed so as to gain weight over the same period. On February 27, half the ewes that had been well fed were changed on to the poorer diet, and half those that had been poorly fed were changed on to the better diet. Rams were put with the ewes on March 16, and the groups run separately until April 4, when they were boxed. With this design it was possible to compare the performance of ewes which had been managed in four different ways during the pre-mating period:

(1) High-High — fed well from mid-December onwards.

(2) High-Low — fed well from mid-December to February 27, and then poorly.

(3) Low-High — fed poorly from mid-December until February 27, and then well fed.

(4) Low-Low — poorly fed from mid-December onwards.

The high-high group, which was heaviest at the time of mating, gave the best lambing percentage, and the low-low, which was lightest, gave the poorest. The other two groups,

the high-low and the low-high, were of approximately the same average liveweight at mating, but the low-high, which was flushed during the few weeks immediately prior to mating, gave a better lambing percentage than the high-low, which was losing condition over this period.

Viewing the Ruakura results and those obtained at Lincoln together, what practical recommendations can be made? The writer would not for one moment suggest that farmers should deliberately set out to put as much condition as possible on their ewes after weaning. In many cases, this would involve a most wasteful use of good feed that could more profitably be kept for other purposes, such as the finishing of lambs and the fattening of cull ewes and cattle. But the results obtained do emphasize most strongly that it can be very poor practice indeed to overdo the process of starving the condition off ewes after weaning. There are good grounds for believing that this practice may be particularly harmful if there is any danger that, as the breeding season approaches, the ewes may have to be shut up and fed short commons as a precautionary measure against facial eczema. Much can be done to ensure a good lambing percentage of thin ewes by placing them on an improved diet some two or three weeks before the start of tupping, but, if the risk of facial eczema prevents this being done, both the ewes and their subsequent lambing percentage are likely to suffer quite seriously.

On most farms a decision has to be made at weaning time how the feed available can be most profitably used. In the present state of knowledge it would seem wise to ensure that feed is conserved for flushing, even if this means having to do the breeding ewes fairly hard after weaning. But there does not appear to be any good reason for grazing the flock any harder after weaning than is necessary to ensure that sufficient feed is saved for the lambs, cull ewes, and cattle, and also for flushing. If the feed supply dictates that the breeding ewes have to be done fairly hard after weaning, any animals in poor condition should be drafted off from the main flock and given preferential treatment. The main consideration is to keep all ewes in reasonably good order, and at all costs avoid any of the ewes being in really poor condition at the time that mating begins.

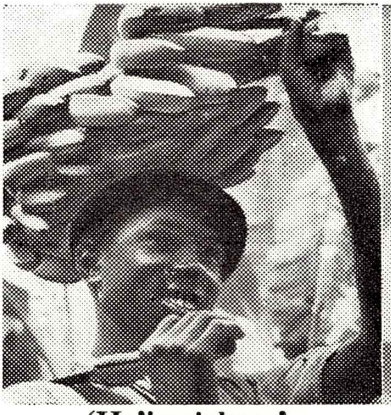
Q:: *Was there any difference in the incidence of bearing trouble in any of the three nutritional groups?*
A:: There was only the odd case of bearing trouble and no clear-cut differences between the three groups. All the ewes, however, were run at the rate of eight per acre over the winter and most of the animals that were very fat at mating had lost a lot of condition by the time lambing began.

Q:: *Did sleepy-sickness become a problem influencing the death-rate of ewes?*
A:: There was only one case of sleepy sickness. This was a medium-plane ewe.

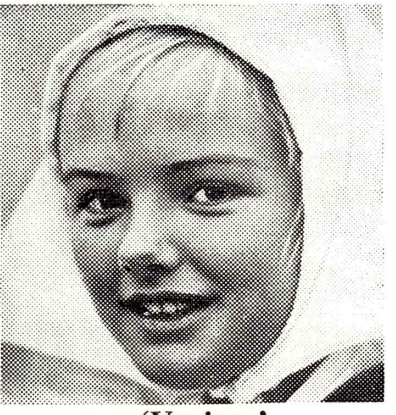
Q:: *Was there any evidence of increased lambing troubles in the high plane of nutrition group?*
A:: No — but it must be remembered that all ewes were fed alike during the pre-lambing period. Had the high plane of feeding been imposed then, this might well have led to increased birth weights and caused lambing difficulties in the case of the heavier single lambs.

Q:: *Is it practical to get two-tooth ewes up to 130 lb at mating and thereby eliminate most of the fertility differences between young and older ewes?*
A:: It would be quite difficult to do under normal farming conditions, especially on much of the hill country of the North Island. The really important thing, however, is probably not to get all two-tooth ewes up to 130 lb at mating but to ensure that all are above the critical weight of about 100 to 110 lb.

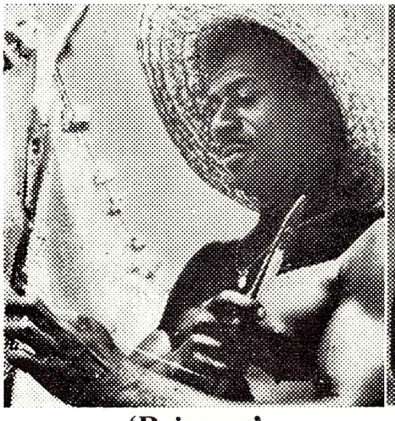
Q:: *Is there not a conflict involved in selection for body weight at mating and selection on the basis of birth rank, in that twin lambs will, on average, be lighter as two-tooths at tupping time?*
A:: It is true that twins will, on average, be lighter as two-tooths than singles at tupping time. For this reason, it is worth while, in selecting replacements, to separate the twins from the singles and select separately within each class.



'Ha'imalahune'
in Papua and New Guinea.



'Vaninna'
in Sweden.



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in Japan.

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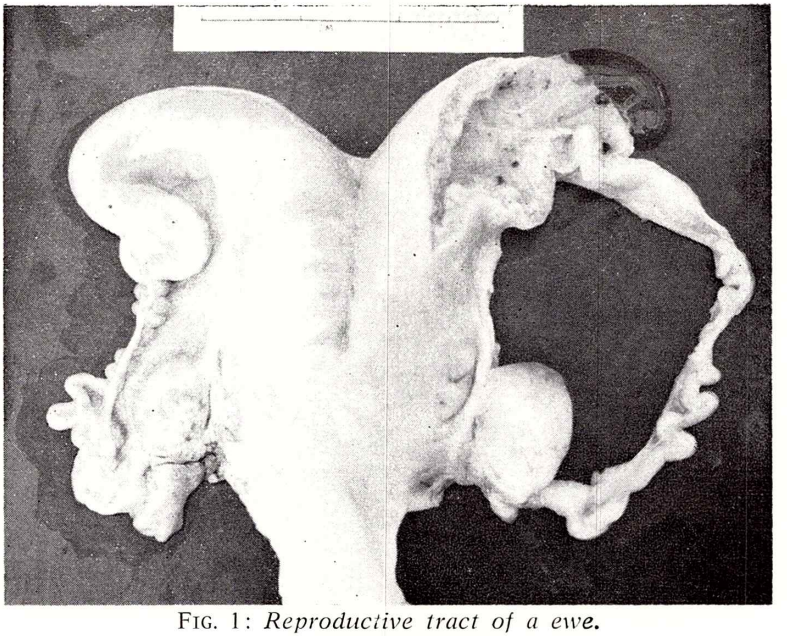

FIG. 1: *Reproductive tract of a ewe.*

SOME ASPECTS OF OVULATION AND EARLY DEVELOPMENT IN THE EWE

M. F. McDONALD*

THE BIRTH of a lamb is the end result of a long chain of co-ordinated events that start in the ovaries of the ewe and end about 150 days later. Interruption of the reproductive process at any stage will result in the rapid death of the unborn "lamb". The object of this paper is to discuss some of the physiological processes that occur during early prenatal life in the sheep.

The paper is presented in two parts. The first provides a brief general description of the normal pattern of formation, development and growth of the lamb inside the ewe; the second part considers in more detail *four* stages of reproduction each having been examined as possible factors which might limit fertility.

PART I

Prenatal Development of the Lamb

A photograph of the reproductive organs from a Romney ewe is shown in Fig. 1. Starting at the bottom, where the

* *Massey University College.*

reproductive tract opens to the outside, is a passage which passes up and divides to form the two horns of the uterus. During pregnancy the lamb develops in the uterus. Each horn is continued into a fine tube which eventually ends in a small funnel (fimbria) that partly surrounds the ovaries.

During the two to three days before the ewe comes on heat, a blister-like swelling, called a follicle, develops on the surface of the ovaries. The follicle contains a developing egg. Towards the end of the heat period, the follicle bursts. One or more follicles may be produced and thus one or more eggs may escape and pass into the fimbria and down into the fallopian tube.

Considering the ovaries again — what happens at the position where the blister burst? The tissue in the vicinity immediately starts to grow to form a dense object (corpus luteum) about the size of a pea which protrudes from the ovaries and can be seen with the naked eye. Thus where there is one corpus luteum one egg has been shed — where

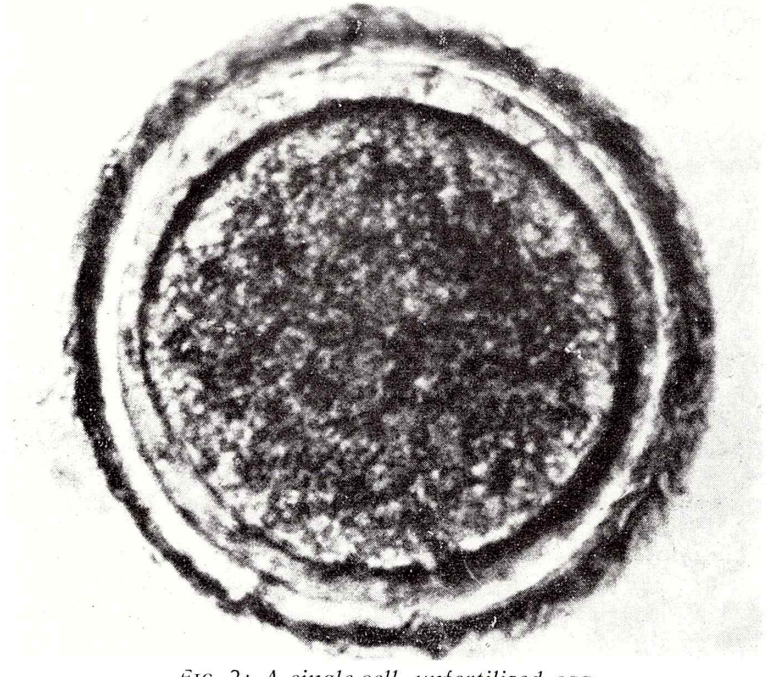

FIG. 2: *A single-cell, unfertilized egg.*

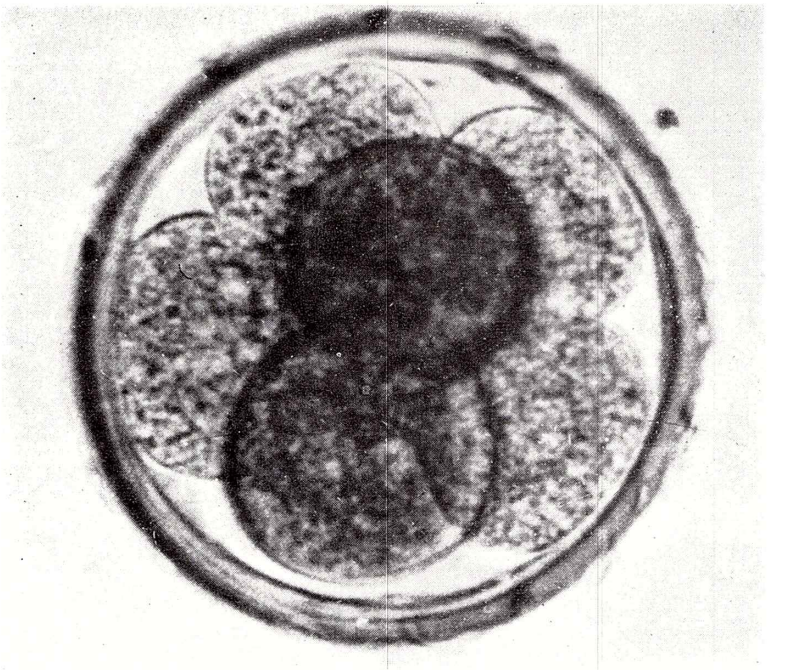

FIG. 3: *A fertilized egg at the eight-cell stage.*

there are two corpora lutea, then two eggs have been released.

If the ewe has mated with a ram, sperm will probably have travelled up the reproductive passage to the top of the tubes ready for the egg to be released. Figure 2 is a photomicrograph of an unfertilized egg from a Romney ewe. The ovum has an outer membrane and an inner mass — called the nucleus. Although many sperms may attach themselves to the outer membrane, only one penetrates through and joins with the inner material. This constitutes fertilization. Approximately 24 hours after ovulation, the egg divides into two cells. After a few hours it splits into four cells and then several hours later into eight cells. A photomicrograph of an eight-cell egg is shown in Figure 3. Because the egg is spherical, the photograph shows only six cells, but, if the microscope had been focused at a greater depth, then two further cells on the other side would have appeared as the top two disappeared.

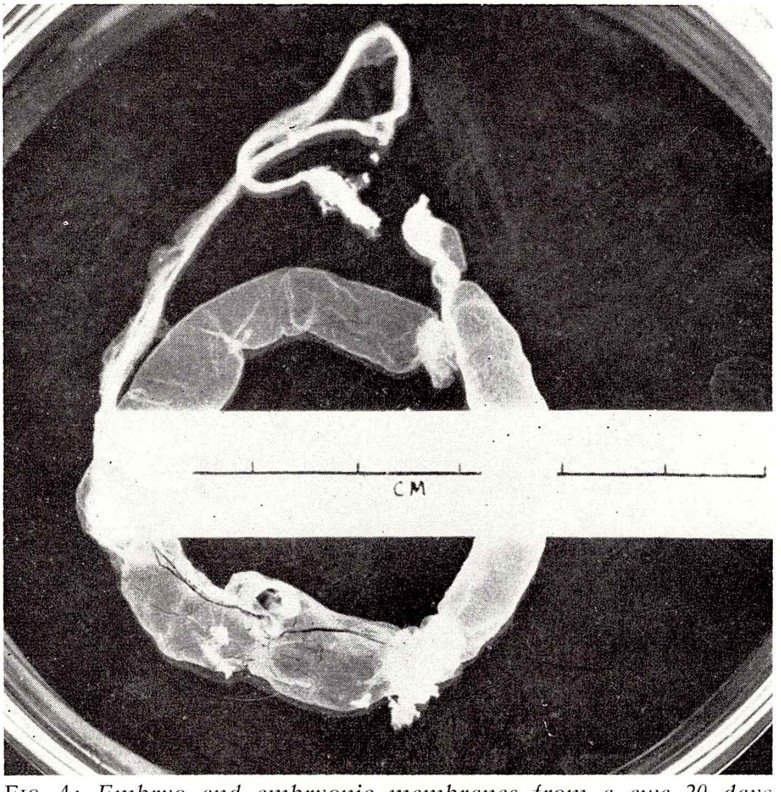

FIG. 4: *Embryo and embryonic membranes from a ewe 20 days after mating.*

The egg continues to divide into 16 cells, 32, 64, and so on, and passes into the uterus late on the third or fourth day. In the uterus there is further cell division, while the egg also increases in size to form a spherical blastocyst about ten times its original diameter. This stage is reached by about the tenth day after mating.

To aid description of the next stage in prenatal development of the lamb, it is helpful to advance events several days and consider what is found in the uterus near the end of the third week of pregnancy. Figure 1 shows the uterus from such a ewe 20 days after mating. The uterine horn has been cut and reveals a membranous sac and a small embryo. Because the membranes are largely transparent, they do not show clearly in the photograph. By opening the uterus further, it is possible to carefully detach

FIG. 5: *Embryo and embryonic membranes, 20 days after mating.*

the membranous sac and embryo from the wall of the uterus. Figure 4 shows the young organism in a glass dish. Even at 20 days after mating, the membranes have spread throughout much of the uterus. The embryo is, however, quite small. Figure 5 shows in more detail the embryo and part of the membranes.

Now to complete the sequence of events from the 10th day, when the egg could be seen as a blastocyst in the uterus, to the embryo on the 20th day. Previously the egg was free inside the uterus, but about the 11th day the developing blastocyst starts to attach itself to the internal lining of the uterus. This is accomplished by membranes which grow out very rapidly from the blastocyst and gradually fuse with the reproductive organ. In other words, the blastocyst commences to implant into the uterus.

However, at the same time, there is complex reorganization of the mass of divided cells resulting in the formation of an embryo. Within the embryo, the first recognizable organs to form occur in the future head region. The primitive brain and heart are readily seen on the 15th day. Within the next few days, the blood vessels develop in the young organism and extend out on to the membranes. Because the membranes are attached to the uterus, nutrients from the blood stream of the ewe may filter through and into the bloodstream of the embryo. At this time also, the other organs of the body are formed — the gut, the liver, kidney, and even the immature reproductive organs of the future lamb are laid down.

In live embryos of about 18 to 20 days of age, examination under the microscope will usually show the heart to be contracting and then relaxing as it pumps blood throughout the blood vessels. The process of implantation is usually regarded as being completed early in the fourth week of pregnancy.

Following this period of development of the embryo and development of a system for nutrition, the remainder

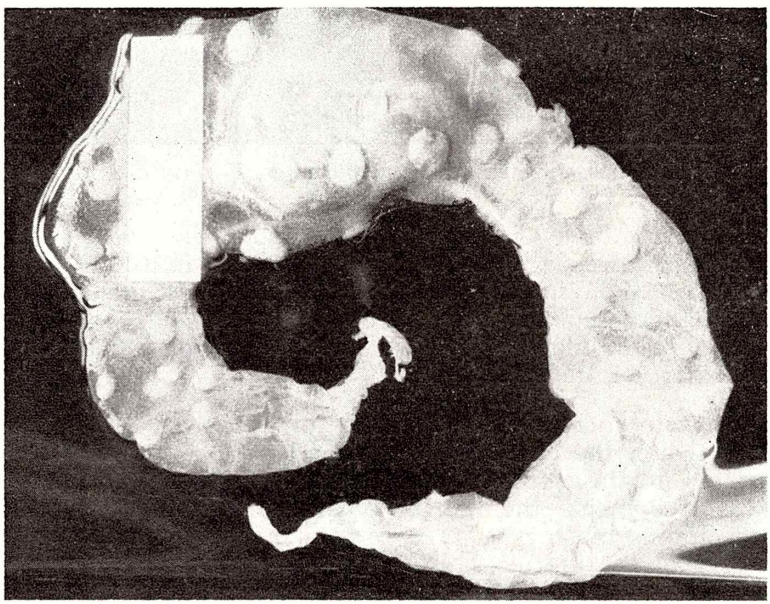

FIG. 6: *Reproductive membranes from a pregnant ewe 43 days after mating.*

FIG. 7: *A 43-day-old "lamb".*

of pregnancy is mainly characterized by an increase in the size of the organism, and in the functioning of its organs. Figure 6 shows the reproductive membranes containing a 43-day-old lamb. The positions or cotyledons where nutrients are transferred from the mother into the unborn lamb are quite obvious. A photograph of the foetus found inside is shown in Figure 7. The lamb is quite normal in size and in shape.

PART II

The *prime* reason for selection of the next four topics for discussion is that they illustrate very well several mechanisms that control reproduction. As a result of research conducted on sheep and other species, there already exists a considerable amount of information on these mechanisms. Thus, in this symposium the work

described by Dr L. R. Wallace on nutrition, by Dr D. G. Edgar on the time of introduction of rams with ewes and by Professor A. L. Rae in relation to breeding, concerns research into the application with New Zealand sheep of several concepts for increasing fertility.

Ovulation

The previous section was concerned with the normal pattern of development of the egg and its growth into a lamb. When more than one egg is produced at a heat period, there is then the potential for more than one lamb to be born. The question may well be asked: What is the normal and average number of eggs produced in a ewe at a heat period? The answer to such a question varies, depending upon factors such as breed of ewe, age, nutritional status and, undoubtedly, several others.

In the case of 5- or 6-year-old Romney ewes, data are available from experiments conducted at Massey University College during the breeding seasons of 1958, 1959 and again in 1963. As the results in each of the three seasons have shown a similar pattern, those of this last year (1963) are presented to illustrate several points concerning ovulation which can have practical significance.

EXPERIMENTAL

One hundred and eighty ewes were available from the College flocks. Each animal was identified by a number branded on to its side and then allocated at random into either of two groups. Both groups were run together in the same or adjacent paddocks. Teaser rams fitted with a sire harness were placed with the ewes on February 20 and were checked for tupping marks every day.

When each ewe in group 1 had her first heat period of the season, an operation was performed and the ovaries inspected. The number of corpora lutea on the ovaries were counted and these counts were regarded as indicating the number of ova shed. The ovaries of all animals in group 2 were not examined until after the third heat period of the breeding season.

The average date when ewes in groups 1 and 2 were examined was March 23 and April 28, respectively. Figure 8 shows the number of eggs produced per ewe for both groups. It is apparent that a greater percentage of ewes produced multiple ovulations at the third heat than did

those examined earlier in the season. The results are in agreement with some studies overseas and in New Zealand and suggest that, at least for mature Romney ewes, the ovulation rate is affected by the stage of the breeding season.

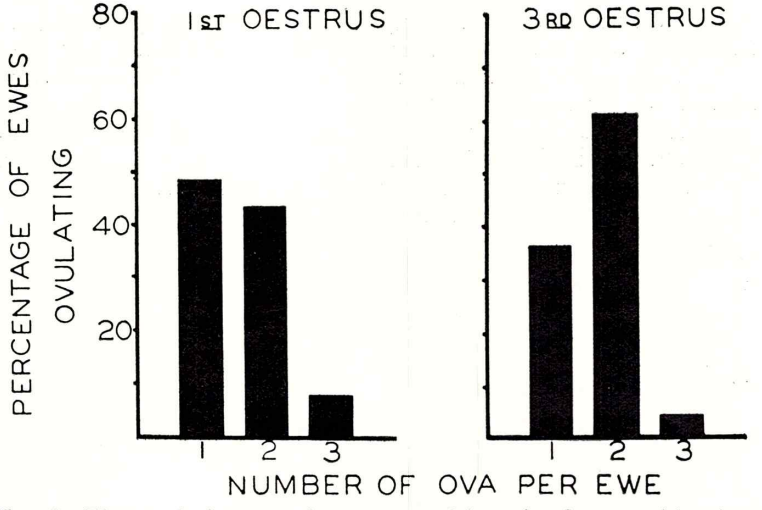

FIG. 8: *The ovulation rate in ewes at either the first or third heat period of the breeding season.*

The variation in number of eggs produced at a heat period — that is one, two, three or even more — illustrates a further factor that could contribute to increased fertility. Here reference is made to the permanent improvement in the fertility of sheep that can result through breeding of ewes selected for high fertility. Thus, selection may act in a flock by increasing the proportion of ewes that *consistently* produce multiple ovulations rather than a single egg at each heat period.

Fertilization of Ova

Following ovulation, further progress in the development of a new organism is dependent upon a sperm meeting with an egg within a short period and usually not more than about 12 hours after ovulation. Thus fertilization has an element of chance about it.

One question that may be asked concerns the usual percentage of eggs fertilized in the ewe and whether this varies according to the number of eggs ovulated?

Data on these aspects can be provided from an experiment conducted at Cambridge (McDonald and Rowson, unpublished data) with 110 mature ewes mostly of the Welsh Mountain breed.

EXPERIMENTAL

The animals were all injected with a preparation of hormone which caused them to come into heat and also to ovulate quite a variable number of eggs. The ewes were mated with rams of proven fertility. Three days later an operation was performed and the eggs collected usually from within the fallopian tube or near to the junction with the uterine horn. Fertilization of the eggs was assessed by examining under the microscope.

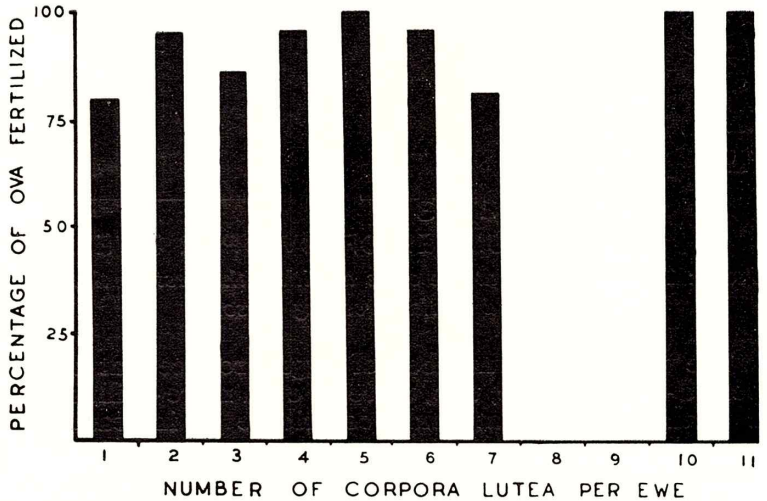

FIG. 9: *The fertilization rate in ewes relative to the number of eggs ovulated.*

Figure 9 shows the percentage of ova fertilized relative to the number produced per ewe. Of the total number of ova shed, 91% were fertilized. It is apparent that the fertilization rate in ewes which produced one egg was about the same as that in ewes with two or more ovulations. Further, it was usual to find that, where twin ovulations had resulted, both ova were fertilized rather than one fertilized and one not.

In case this experiment might be regarded as artificial and the findings somewhat "unnatural", the results from a

study conducted at Massey University College this year may be of interest. Thus, in mature Romney ewes mated at their normal heat periods, the fertilization rates in animals which produced one or two ovulations were 86% and 90%, respectively. Certainly the percentage was not lower in the ewes which shed two ova.

Egg Transport in the Fallopian Tube

The time at which the egg passes from the tube into the uterus is critical if it is to continue to live and to develop. It is well known that only a short period exists when the uterus is fully receptive to implanting the egg. If the egg reaches the uterus too early or too late, then death of the young organism generally occurs. Several factors are known to influence the rate at which the egg is transported through the tube and its time of entry into the uterus. Thus, it was of interest to determine the normal time taken for the egg to travel through the tube and to examine whether the rate of travel was similar in ewes where single or multiple ovulations occurred.

EXPERIMENTAL

Mature Romney Marsh and Welsh Mountain ewes were available. Careful and frequent observations were made for the onset of heat and the ewes were then mated to fertile rams. The assumption was made that ovulation occurred 24 hours after the first observation of a tupping mark. The ewes were slaughtered at various intervals up to three days after ovulation and the reproductive organs collected. The fallopian tubes were laid out straight and divided into six equal-sized sections. The inside of each piece of tube was then washed out with fluid to locate the ova. The distance travelled in the tube and the stage of development of the egg at standard times after ovulation were thus determined.

Fertilized, but not yet divided, eggs were found in the top three segments adjacent to the ovary. Two-cell eggs were usually present half-way down the tube 24 hours after ovulation, and four-cell eggs lower still several hours later. Eggs at the eight-cell stage and even more advanced stages of development have always been found in the bottom segment of the tube (also in the uterus).

Comparison of the distances travelled in the tubes by eggs of comparable age from ewes with one or two ovulations suggests there was no marked difference in the rate of

travel. Further, where two eggs were released by the same ovary, both were usually found in the same segment or at least in adjacent sections of the tube. Likewise, where eggs have been released by both ovaries in a ewe, they were usually in similar positions in the right and left tubes. Thus, it seems likely that, when multiple ovulations occur (at least up to three), the ova are transported through the tube and into the uterus in the same manner and rate to that in ewes which release a single ovum.

The Survival and Development of the Embryo in the Uterus

Almost all of the life of the unborn lamb is spent in the uterus. Thought of in another way, most of the export lambs in New Zealand which are killed at, or soon after weaning, spend well over half of their whole life in the uterus of their mother.

Any failure on the part of the uterus to function properly must limit the ewe's fertility. Consequently, many studies on reproduction have been devoted to a better understanding of factors which affect the uterus. A fundamental yet practical question that might be asked concerns whether the uterus of the ewe has the potential to support a multiple number of lambs rather than one lamb?

It may be thought that this information could be obtained by comparing the lambing percentages of ewes which had shed one and two eggs, respectively. However, as previously pointed out, failures of fertilization in some eggs, and possible faults in the transport of eggs to the uterus must confuse the answer to a question which really concerns the uterus and its potential as a lamb factory.

Instead, to avoid these problems, use has been made of an experimental technique whereby fertilized sheep eggs are placed directly into the uterus of the ewe and studies made on their subsequent development. Under optimum conditions better than 60 to 70% of ewes may be expected to conceive following this treatment. The results of an experiment conducted by N. W. Moore, L. E. A. Rowson and R. V. Short (*J. Reprod. Fertil., 1*: 332 (1960)) who utilized this technique, is of interest to the present discussion. These workers transferred fertilized eggs into the reproductive organs of eighty ewes at the rates of five eggs (group 1) and two eggs (group 2) per animal. Some ewes in both groups were killed during the third week after mating, while the remainder were allowed to proceed to the end of prenancy and to lamb.

Considering first the ewes in group 1. Examination of the reproductive organs in the animals that were slaughtered revealed the number of normal embryos which were alive three weeks after mating. At this time, of the original five eggs transferred per ewe, only 2.5 were represented by live embryos — the remainder had died either as eggs or as early embryos. In the sheep allowed to terminate pregnancy normally, 2.4 eggs per sheep on average survived and became lambs.

Corresponding data from the ewes in group 2 showed that, of the original two eggs transferred per sheep, 1.6 embryos were alive at the third week after mating and 1.5 lambs were born.

These and other studies have shown that the uterus of the ewe does have the potential to support a multiple number of lambs. Further, in the ewes that received the greatest number of fertilized eggs, more survived and developed into embryos and even into lambs than resulted in ewes where only a small number of eggs reached the uterus. Finally, the experiment showed that, as far as prenatal losses are concerned, a most critical period in the life of the developing lamb is within the first month of pregnancy. This is the time when the fertilized egg exists free within the reproductive organs and the embryo is being formed, together with development of a system of membranes, through which the mother can pass nutrients into the bloodstream of the young organism. Once this period is successfully accomplished, and provided nutrition, genetic factors, and infectious agents do not become limiting, a lamb is likely to be born.

Conclusion

The normal pattern in the development of a lamb from an egg has been described. In mature sheep, one, two and perhaps even more eggs may be released at a heat period — thus there is often the potential for a multiple number of lambs to be born. Consideration of stages in the reproductive process which might limit fertility reveals that where two eggs are produced in a ewe:

(a) Both eggs are as likely to be fertilized as are single eggs in other ewes;

(b) Both eggs travel down the fallopian tube and enter the uterus at about the same time as do single eggs in ewes; and

(c) Where a multiple number of eggs reach the uterus, more lambs are likely to be produced than in ewes where a single egg passes into the uterus.

Finally there is evidence that, of the ova produced in normal healthy ewes, prenatal death usually is more likely to occur during the first month of pregnancy than during later stages.

Acknowledgements

Part of these studies were conducted at the University of Cambridge during tenure of the Shaw Savill Centenary Scholarship and a grant from the New Zealand Wool Board. The assistance extended by members of the University and the A.R.C. Unit of Reproductive Physiology and Biochemistry, Cambridge, is appreciated.

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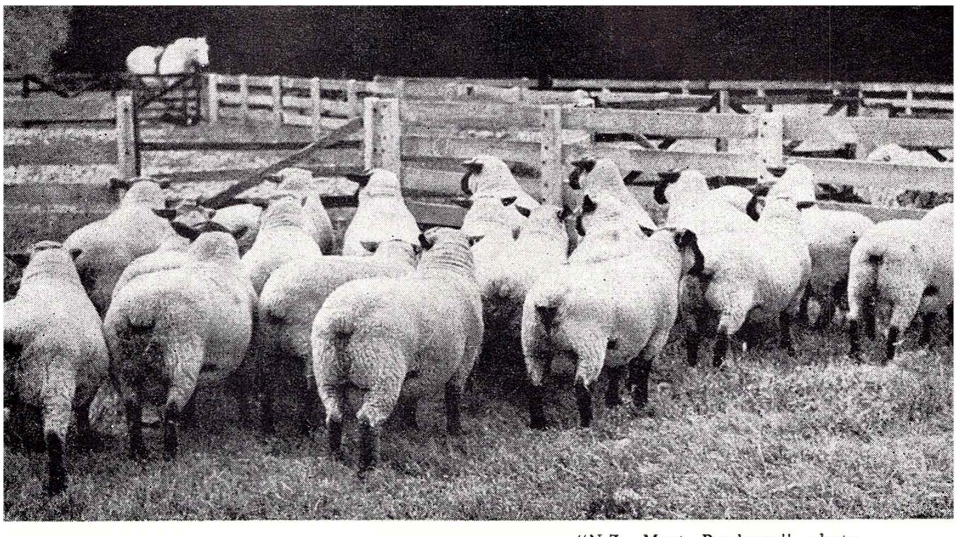

"N.Z. Meat Producer" photo

THE INFLUENCE OF RAMS ON THE ONSET OF THE BREEDING SEASON IN EWES

D. G. EDGAR AND D. A. BILKEY*

EWES BREED in the autumn because they are stimulated by the shortening hours of daylight, and sheep transferred from one hemisphere to the other alter their breeding season by six months, to conform to the new light environment. It is possible to cause ewes to mate in the spring by enclosing them in a darkened building and controlling the amount of artificial light they receive. The ratio of daylight to dark, therefore, determines that ewes will breed in the autumn, but the exact date is influenced in some degree, by other factors. For example, it has been shown experimentally that temperature has an effect; ewes kept at temperatures below the autumn average began to breed sooner than sheep kept at average autumn temperature. There may be other influences which are at present unknown, perhaps feed quantity or quality, but the factor to be considered here is the influence of the time of joining the ram on the onset of the breeding season in the ewe.

* *Ruakura Animal Research Station, Hamilton.*

Australian workers found that, if the rams join the ewes when the latter are approaching their breeding season but before they experience the ovulation without heat (silent heat) which often precedes their first heat, many of the ewes are stimulated to ovulate within about five or six days and come into heat about 17 days later, that is, approximately 22 days after joining the rams. Once the ewes have commenced their own breeding cycles, the presence of the ram cannot affect them in this way. This paper reports the results of studies of this phenomenon in Romney ewes in New Zealand.

Experimental

In 1961, 300 five-year-old Romney ewes at Ruakura were equally divided into three matched flocks. Flock A joined fertile rams on February 10; Flock B, from the adjacent paddock, joined Flock A and the rams on February 20, and Flock C, from one paddock further away, joined Flocks A and B and the rams on March 2, about the usual time for this area.

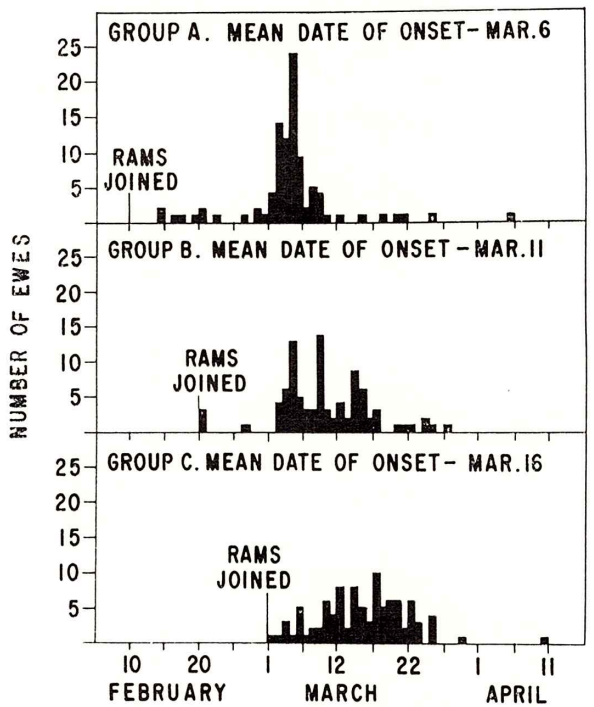

FIG. 1: *The mean date of onset of oestrus in five-year-old Romney ewes, 1961 experiment.*

The onset of the breeding season was clearly influenced by the treatments (Fig. 1). The mean date of the onset of the breeding season in Flock A was March 6, in Flock B March 11 and in Flock C March 16.

The fertility of all flocks was the same, and the mean date of the first successful tupping in the three flocks was March 10, 15 and 20, respectively.

Although there was little activity in the ewes of Flock C in the same paddock at the same time, the peak of tupping in Flock A, about 22 days after joining with the rams, is clearly shown. This leads to both an earlier and relatively concentrated lambing.

Flock B is interesting in that the ram effect is evident sooner than the expected 22 days after joining. This is perhaps due to the ewes being in the paddock next to the rams from February 10; the stimulus having a diluted effect compared with Flock A. Australian workers have shown that the sound and/or smell of rams, without sight or contact, stimulates ewes. It seems likely that the smell of the rams may be important, as in mice the smell of the male influences reproduction in the female.

It seemed clear then that the onset of the breeding season in mature Romney ewes in New Zealand is influenced by the joining of the rams. It was, however, desirable to determine if young ewes were susceptible, what was the optimum time to join the rams for maximum effect, and if vasectomized teaser rams were equally effective.

A study with two-tooth ewes was carried out in 1962 at the Hautu Prison Farm, where 900 two-tooth Romney ewes were divided into three equal flocks, each of which was kept separated from rams or teasers by at least one paddock before joining. Groups A and B were joined each with eight rams on February 10 and March 2, respectively. Group C was joined with three teasers on February 10 and these were replaced by eight rams on March 12. From Fig. 2 it can be seen that the breeding season of the two-tooth Romney ewes in Group A (mean date of onset March 10) has been advanced when compared with Group B (mean date of onset March 21), by the earlier joining of the rams. In this experiment, however, the teasers introduced to Group C on February 10 have had no effect in advancing the breeding season in the group of ewes, although they tupped some which came in heat, as the mean date of the onset of the breeding season was delayed until March 25. The peak of tupping in each of the three groups falls about 22 days after the introduction of rams.

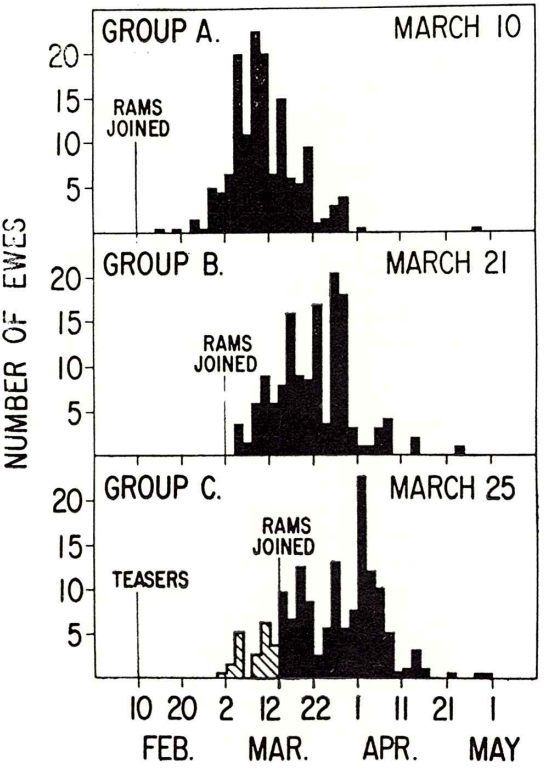

FIG. 2: *The mean date of onset of oestrus in two-tooth Romney ewes, 1962 experiment.*

In 1962 at Ruakura, four groups of 100 ewes were each joined by one ram on January 10, February 1, February 10 and March 2, respectively, one group of 100 ewes was joined by one teaser on January 10 and a group of 200 ewes by two teasers on February 1. All the ewes were five-year-old Romneys, and rams replaced the teasers in the last two groups on March 2.

The results are shown in Fig. 3. Compared with the control group, Green, joined with the ram at the usual time at the beginning of March and with a mean first tupping date of March 20, the greatest advance in the breeding season was obtained by joining the ram on February 1 with Group Red in which the mean onset of the breeding season was March 6. A smaller advance in onset was obtained by joining

the ram earlier on January 10 (Yellow Group), and later, on February 10 (White Group). The optimum time appears to be about the beginning of February, perhaps when most of the ewes are susceptible, or when all the ewes are most susceptible to stimulation by the rams, and when few of them have initiated their own breeding season by experiencing their silent heat.

The teasers which joined Groups Black and Blue on January 10 and February 1 respectively appear to have influenced the onset of the breeding season but to a lesser extent than the rams joined on the same dates. When the records were re-examined, it transpired that Groups Black and Blue had been shut up for facial eczema control adja-

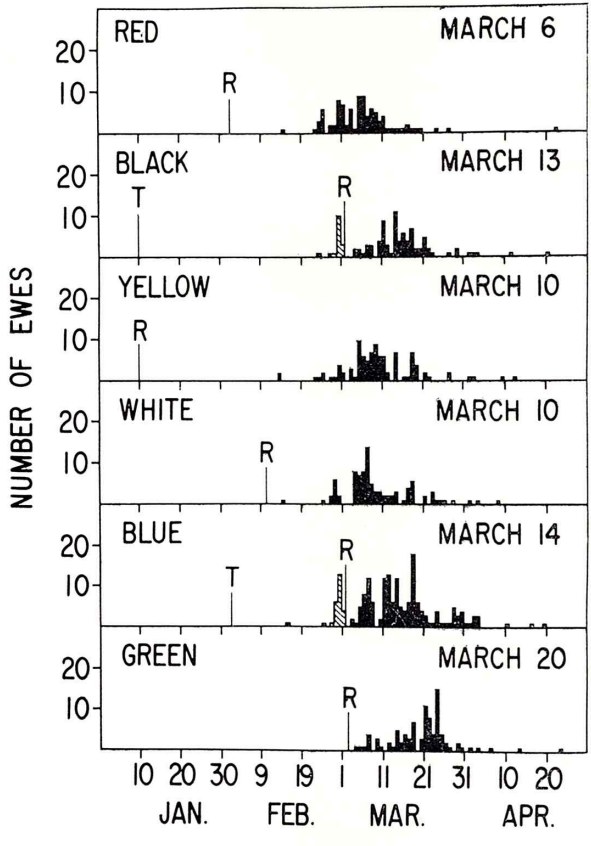

FIG. 3: *Mean dates of onset of oestrus in Romney ewes in relation to 1963 experiment.*

cent to other groups with rams, at the beginning of February, so that the effect due apparently to the teasers may, in fact, have been caused by proximity to rams.

On a third property, in 1962, four teasers introduced on February 10 to 700 mixed age Romney ewes had no effect on the breeding season. The onset in this group was stimulated by rams joined on March 12 and was later than in the similar control group joined with the rams on March 1.

As in 1961, the order of lambing of the groups in the 1962 experiments at Ruakura was the same as the order of first tupping, the mean lambing dates ranging from August 1 for Group Red to August 17 for Group Green. The lambs from these ewes were weighed at fortnightly intervals and slaughtered at a set weight. The earlier lambing groups retained their advantage, 75% of Group Red being slaughtered by December 20, compared with January 10, 1963, for the same proportion of Group Green, the other groups falling between these extremes. This situation may alter with variations in pasture growth between seasons, but, if generally true, is probably of considerable economic importance.

Experiments in 1963 were designed to investigate further the effectiveness of teasers, and to increase twinning rate without unduly delaying lambing.

At the Brooklyn Outstation of Ruakura, two teasers vasectomized one year, and two vasectomized three weeks, were each joined with a group of approximately 200 mature Romney ewes on February 1, and each pair of teasers was replaced by two rams on March 1. Although the recently vasectomized teasers worked among their ewes more actively, and lightly marked 16 ewes in attempting to mate with them, only one ewe in each group was tupped during February, and the teasers had no effect on the breeding season, the mean onset in one group being March 21 and in the other March 23, about the expected date when rams are joined on March 1.

In another experiment this year, teasers appeared to have some effect when introduced on February 1, but by mistake the group was in a paddock adjacent to rams for the first week in February, so that this result must also be suspect. The usefulness of teasers to advance the breeding season in ewes is doubtful, but they appear to be effective in detecting ewes when they come into heat.

At Hautu this year, three groups of 250 two-tooth Romney ewes have been submitted to different mating managements. Groups A and B were each joined by seven rams on February 1 and March 1 respectively, while Group C ran

with seven rams from February 1 to 14 when the rams were withdrawn and rejoined on March 14. From Fig. 4 it can be seen that, compared with the control Group B (mean onset, March 19), the mean onset of the breeding season in Group A has been brought forward 21 days to February 26. On the other hand, in Group C the mean tupping date is March 24, 5 days later than Group B.

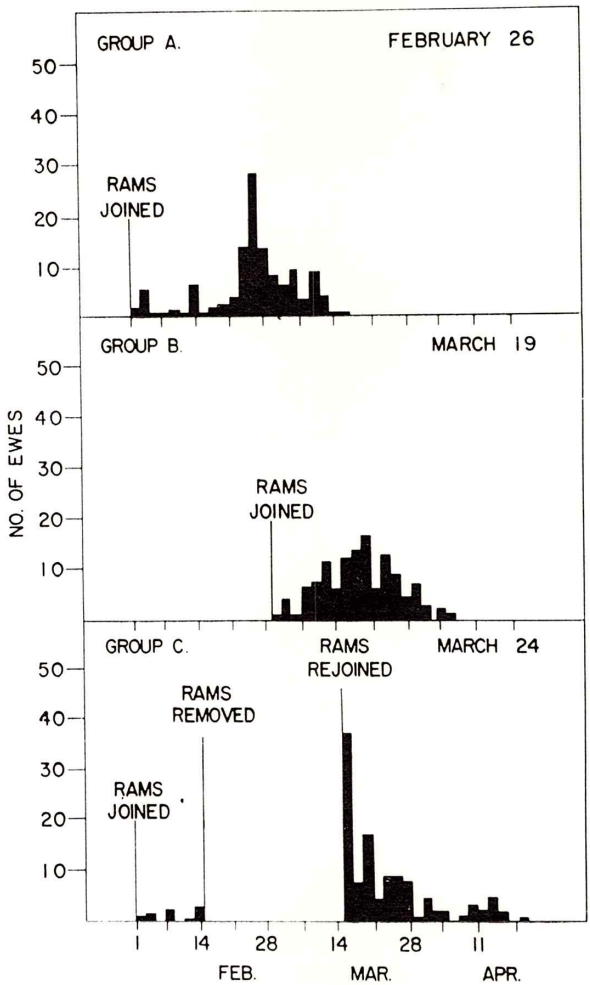

FIG. 4: *Mean dates of onset of oestrus in Romney ewes in relation to date of joining with rams and to their removal and later rejoining, date of joining either teaser (T) or fertile fams (R), 1962 experiment.*

From studying these histograms, it seems that, provided the ewes in Group C were stimulated as in Group A by the rams at the beginning of February, all the ewes in Group A have been tupped at their first heat, in Group B most were at their first heat, but some were at their second heat, while in Group C, a few were at their first heat, most were at their second heat and some were mated at their third heat. Since it is known that ovulation rate in ewes goes up with successive heat periods at the beginning of the breeding season, the opportunity for multiple births increases from Group A to Group B to Group C.

In a similar experiment with mature ewes at Ruakura, the twinning rate of 250 ewes, joined with the rams on March 1 and with a mean season onset of March 23, will be compared with the twinning rate of another group of 250 ewes, joined with the rams for two weeks from February 1, and rejoined on March 15. The mean tupping date in this latter group was March 30. The lambing of the ewes in these two experiments is awaited with considerable interest.

It appears that the following conclusions can be drawn from the results of the experiments in 1961, 1962 and 1963:

(1) The presence of the ram influences the time of onset of the breeding season of Romney ewes in New Zealand.

(2) Both young and mature ewes are so influenced.

(3) The maximum advance in the onset of the breeding season is obtained by joining rams and ewes at about the beginning of February.

(4) The fertility of the ewes is not affected, so that an advance in the time of onset of the breeding season is followed by an advance in mean lambing date.

(5) Teasers are less effective than rams, and sometimes have no effect, in stimulating ovulation in susceptible ewes, although they mark ewes when they come into heat.

(6) In the one season in which it was studied, earlier mean lambings resulted in earlier slaughtering of lambs.

(7) It appears possible to have ewes tupped at their second heat period at about the same time as they would ordinarily be experiencing their first oestrus. This might increase lambing percentage with little change in lambing date.

DISCUSSION

Q:: *What is the percentage of rams put out with the ewes at the start of the tupping season?*
A:: At Ruakura, one per cent. of rams is used both to stimulate and to mate the ewes.
Q:: *Could you produce the "ram effect" in ewes by grazing rams in an adjacent paddock?*
A:: In the 1961 experiment at Ruakura, there did appear to be an effect due to the presence of rams in the adjacent paddock but it was less marked than that produced by rams in the same paddock as the ewes.
Q:: *Is there a "ram effect" when rams are left with the ewes all the year round?*
A:: In Australia in these circumstances, the ewes appear to be unstimulated by the presence of the rams.
Q:: *Some districts are known as "early" and others are known as "late" with regard to the onset of the breeding season in ewes. Have you any information on the effect of country or district on the breeding season of the ewe?*
A:: Apart from possible effects due to temperature, nothing is known of the effect of district on the onset of the breeding season.
Q:: *When rams are joined with ewes early in February instead of the usual time in March, what effect has this practice on the fertility of the rams?*
A:: It appears to have no effect. The same proportion of ewes is settled at each time.
Q:: *How can a farmer reconcile your advice in putting rams out early and Dr Wallace's advice of flushing the ewes before mating in those districts where there is little feed available in the late summer?*
A:: Tupping should take place on the best pastures available. Feed availability is one factor to take into account in deciding when to turn out the rams.
Q:: *Should the rams be "flushed" before joining with the ewes?*
A:: The rams should be in good but not overfat condition. They seem to work effectively whatever the degree of pinkness of the skin in the groin.
Q:: *What was the "flushing" programme in your first experiment?*
A:: The ewes and rams were on the best pasture available on the Ruakura sheep farm.

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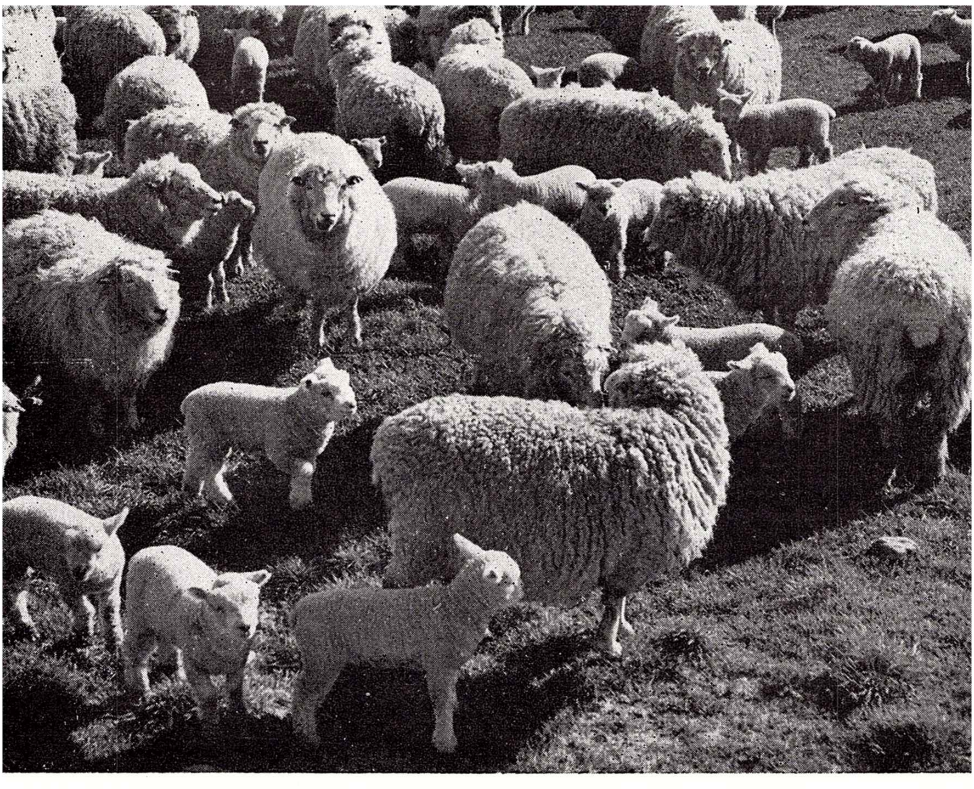

BREEDING FOR BETTER LAMB PRODUCTION

A. L. RAE*

IN INTRODUCING this discussion on breeding for better lamb production, it is important to define at the outset the characteristics which will be considered and to make some comment on their nature.

First of all, it is necessary to outline how fertility can be measured on the individual ewe. Although there are many ways in which this can be done, there are only two methods which can be used with comparative ease, at least in stud flocks. They are:

(1) *The number of lambs reared by a ewe*: A ewe will rear, none, one, two or, very occasionally, three lambs in any given year. Sometimes this can be subdivided further; for example, distinction can be made within the ewes having no lambs between the true dry ewe and the ewe which has lost her lamb. This is the simplest measure of lamb production and the information on each ewe should be available in the records normally kept in a stud flock.

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(2) *The total weight of lambs weaned by the ewe:* This measure is a refinement which requires weighing the lambs at weaning. It includes the information given in (1) above but, in addition, the weights of the lambs give information on the ability of the ewe to milk and rear the lambs.

Most of the discussion will be devoted to the number of lambs reared but the same general principles apply to weight of lamb weaned per ewe.

From the viewpoint of improvement by breeding, it must be noted that both number and weight of lambs weaned are characteristics of the ewe and can only be measured on the ewe. No direct information is available on the ram, the only indications of his likely ability to breed daughters with high lamb production coming from the performance of his female relatives. This feature of lamb production must be strongly emphasized because it differs markedly from most other characteristics of the sheep which can be measured on both the ewe and the ram and therefore can be selected directly in both sexes.

A further point to stress is that, in talking about a ram being good or poor for lamb production, it is meant that he will pass on to his daughters a good or a poor inherent ability to produce lambs. The statement does *not* refer to the ram's ability to get lambs from the ewes to which he is mated, this being an entirely different characteristic. To avoid confusion, the term "breeding value for lamb production" will be used to describe the ram's ability to pass on lamb production to his daughters. In effect, the breeding value of the ram would be equal to the average lamb production of a very large number of his daughters.

The problem of breeding for increased lamb production is thus, primarily, the problem of how best to assess the breeding value of rams or ewes for lamb production, so that the best can be selected for flock replacements. In doing this, the objective is to improve generation by generation the average level of lamb production in the flock. A second aspect which is important is how best to assess those ewes which during their *own* lifetime in the flock will have a high level of lamb production. Thus, in one case, concern is for improvement in the next generation while, in the other, it is devoted to improvement in the present generation. Fortunately, however, there is little evidence that the two conflict.

In this paper, the intention is to review the present state of knowledge concerning these two problems and to sug-

gest some ways in which this information can be supplied. In doing so, it is convenient to divide the discussion into two parts:

(1) Methods which can be used in stud flocks, and

(2) Methods that can, in many circumstances, be used in commercial flocks.

In making this division, it is not intended to imply that there is any difference in the basic problem between the two types of flock. The reason for the division is that in stud flocks, where individual identification and recording of ewes and rams are necessary, more detailed methods can be used.

Selection for Lamb Production in Stud Flocks

Selection of Rams

As mentioned earlier, the main information on which an assessment of the breeding value of a ram can be made comes from the records of lamb production of female relatives. For example, some or all of the following types of information can be available in a stud flock:

(1) The lambing performance of daughters of the ram.

(2) The number of lambings the dam has had and the number of lambs she has reared.

(3) The number of lambings and the number of lambs reared by one or both of the grandams.

(4) The lambing performance of the half-sisters of a ram.

PROGENY TESTING

Using the lambing performance of the daughters of a ram as a means of assessing his breeding value, is a progeny test. There is no doubt that this is the most accurate way to determine the breeding value of the ram. It has one major disadvantage — the ram is already aged by the time he is progeny tested. For example, a ram born in the spring of 1960 and used as a two-tooth has his first crop of daughters born in spring 1962. These daughters, in turn, do not have their first lambing until spring 1964, and the first time that the ram can be used as a progeny-tested ram is in autumn 1965, when he will be 4½ years of age and will have only a short remaining useful life. Under New Zealand conditions, this is a sufficiently serious disadvantage to limit the usefulness of the method. It is worth noting that this disadvantage is not of great moment in breeds in which it is normal to mate both ewes and rams

as lambs, in which case a ram is only two years old when the progeny-test information becomes available.

A further point about progeny testing is worth making. If, in the future, artificial insemination is to be used as a technique of breed improvement, then it will be essential to use progeny testing, simply because one cannot afford to run the risk of using a ram widely unless his performance is known as accurately as possible.

THE LAMBING PERFORMANCE OF THE DAM

The main problem in ram selection is that of selecting the two-tooth ram. As the dam is the closest female relative, her lamb production is the most useful information in assessing the breeding value of her son. It is important, therefore, to have a simple way of using this information.

The problem is indicated by the following example:

Two-tooth Ram A: His dam reared 5 lambs in 4 lambings.

Two-tooth Ram B: His dam reared 3 lambs in 3 lambings.

Two-tooth Ram C: His dam reared 2 lambs in 2 lambings.

How can one rate these rams from the point of view of their breeding value for lamb production? One method would be to set a minimum standard below which a ram would not be selected. For example, one would not select a ram unless his dam had reared at least five lambs in three lambings. This is a reasonably satisfactory way but does not completely solve the problem because there could be rams that are potentially better whose dams have had either more or fewer than three lambings.

Another simple method which some breeders have used is to express the number of lambs as a percentage of the number of lambings. In the example above, the rating of the rams would be: A — 125%; B — 100%; C — 100%. This rates rams B and C as being equal, but the fact that the dam of B has had three lambings makes the information on her slightly more accurate than the two lambings of the dam of C.

A more accurate answer, based on evidence from a number of studies, is available, and, although it is more complex than the above methods, it can be reduced to a table which makes it just as simple to use. The comparisons are given in Table 1, where an index representing the breeding value of the ram can be read off from the number of lambs pro-

TABLE 1: The Lamb Production Index Based on the Dam's Records
(corrected for age)

Number of	*Number of Lambings*								
Lambs	1	2	3	4	5	6	7	8	9
1	509	440	392	364	344	327	315	304	295
2	571	490	433	400	375	355	340	327	316
3	634	540	475	436	406	383	365	350	337
4		590	517	471	438	411	390	373	358
5		640	558	507	469	439	415	395	378
6		690	600	543	500	466	440	418	399
7			642	578	532	494	465	440	420
8			683	614	563	522	490	463	441
9			725	650	594	550	515	486	462
10				685	625	577	540	509	483
11				721	657	605	565	532	504
12				757	688	633	590	554	524
13					719	661	615	577	545
14					750	689	640	600	566
15					781	716	665	622	587
16						744	690	645	608
17						772	715	668	629
18						800	740	691	649
19							765	713	670
20							790	736	691

duced by his dam in a given number of lambings. It should be noted that the index is merely a figure which ranks the breeding values of rams whose dams have differing numbers of records. It cannot be interpreted in terms of lambing percentages or number of lambs. While it would be informative to have a figure that could be thus interpreted, to do so would spoil the simplicity of the table.

Adjustments have been built into Table 1 to allow for the fact that two-tooth and four-tooth ewes normally have a lower lambing percentage than do ewes of older ages.

Since Table 1 was published in 1958, a considerable amount of experience has been obtained in its use and a detailed assessment is being undertaken at present by J. N. Clarke at Massey College. Though no detailed conclusions can be given at this stage, some general observations are possible.

(1) One may question whether Table 1 can be used satisfactorily over a wide variety of flocks which are likely to differ in average lambing percentage and in the adjustments required for age of dam. The important point is whether, over a wide variety of conditions, Table 1 ranks

the rams in the proper order, not the absolute figure which it places on each ram. Experience has shown that the table does, in fact, give the same ranking over a wide range.

(2) A second problem raises the question of a basic assumption which is involved in Table 1; that the dry ewe, the single-bearing ewe, and the twin-bearing ewe can all be measured on the same scale. If the inheritance of sterility, for example, is very different in kind from the inheritance of fertility, then the use of Table 1 could lead to the wrong emphasis as between dry ewes and twin-bearing ewes. An earlier investigation by T. S. Ch'ang of Massey College in an experimental Romney flock indicated that the heritability of failure to lamb was essentially the same as that of twinning and that the scale as used here was satisfactory. The writer suspects, however, that this could vary between flocks and believes that the question merits further investigation.

(3) A third question which is currently being investigated by J. N. Clarke is whether the sequence of lambings has any bearing on the accuracy of selection. For example, consider two ewes with the following records:

	Two-tooth Lambing	*Four-tooth Lambing*
Ewe A	Single	Twins
Ewe B	Twins	Single

Both of these ewes have three lambs in two lambings and are therefore ranked as being the same in Table 1. The indications are, from the study of the performance of offspring of the two types of ewe, that B is better than A and that modifications to the table to allow for this would be worth while.

LAMB PRODUCTION OF THE GRANDAMS

It is possible, thought somewhat more difficult, to use the lamb production records of the grandams in addition to the production of the dam in assessing the breeding value of a ram. While there is nothing wrong in principle in using the records of the grandams, there are several points to note:

(a) The accuracy of selection is increased only a little by including the records on the grandams. One reason for this is that much of the information which the grandmothers can give on the breeding value of the grandson is already given by the dam. This will be especially the case in flocks where the sires used are normally ob-

tained from another stud flock. In these circumstances, the information on the paternal grandam will usually not be available.

(b) The information on the grandams will be less reliable than that on the dam. For example, the grandams will often have had their lambings some years earlier in the history of the flock. If management in the flock has changed in the meantime, the records of the grandams will sometimes be quite misleading.

LAMB PRODUCTION OF HALF-SISTERS

Some of the two-tooth rams will have half-sisters which have lambing records in the flock. Where this is the case, these records are very important in increasing the accuracy of selection of two-tooth rams. Figure 1 shows the relationship of the half-sisters to the two-tooth ram and emphasizes that the records on the half-sisters are essentially a progeny test of the sire of the two-tooth ram. Thus, in selecting a ram on his half-sisters' performance, a son of a proven sire is being selected.

The first point to note is that not all the two-tooth rams in any one year will have half-sisters in the flock. For example, a sire born in 1954 would have his first crop of rams and ewes born in 1956. When the first crop of two-tooth rams by this sire are to be assessed in late 1957, none of his daughters would yet have had a lambing in the flock. However, for his second crop of two-tooth rams which would be assessed in late 1958, the lambing performance of half-sisters (the first crop of daughters of the sire) will be available.

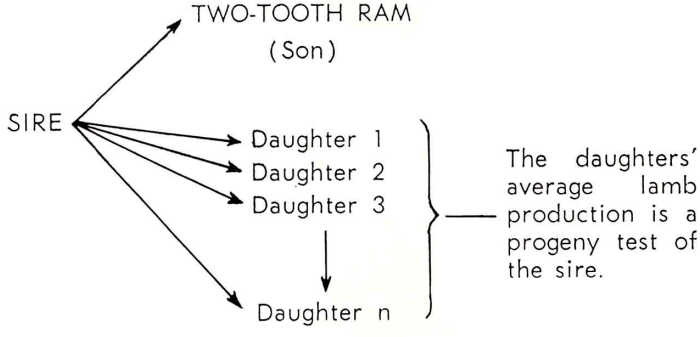

FIG. 1: *Relationship of the half-sisters to the two-tooth ram.*

Secondly, the extent of the increase in accuracy as a result of using information on half-sisters depends mainly on the number available, but will be worth while if 10 or more have records in the flock. The factors which adjust for differing numbers of half-sisters are given in Table 2.

The method of combining the production of the half-sisters with the production of the dam is shown in Appendix 1.

TABLE 2: Factors for Adjusting for Differing Numbers of Half-sisters

Number of Half-sisters	*Factor*	*Number of Half-sisters*	*Factor*
10	2.4	25	4.5
12	2.8	27	4.7
15	3.3	30	4.9
17	3.5	35	5.3
20	3.9	40	5.6
22	4.2		

Selection of Ewes

There are a number of aspects to the selection of ewes in stud flocks and a variety of things that can be done, but often little real information on the comparative advantages of different methods.

SELECTION OF TWO-TOOTH EWES TO ENTER THE FLOCK

Rising two-tooth ewes have not yet had the opportunity to have lambs; hence, in the absence of other information, the production of their dams is the best basis for assessing their likely performance. Consequently, Table 1 can also be used for assessing the breeding value of two-tooth ewes as well as two-tooth rams. Information on other relatives of the ewes will not usually be worth taking into account.

There is urgent need for some more direct way of picking early in life those ewes which will subsequently perform well, and it is hoped that the method of recording the number of oestrous cycles of the ewe lamb which is being investigated by T. S. Ch'ang may be of material assistance in this problem.

DRY EWES

As has been shown by earlier papers in this symposium, a ewe can be dry for many different reasons. Consequently, dry ewes are not a homogeneous group and the question of whether to keep or cull them is not simply answered.

The dry two-tooth ewes are the most important group. There is a considerable amount of information available in New Zealand about the subsequent performance of the dry two-tooth. For example, Edgar (1958), in an investigation at the Whatawhata Hill Country Research Station, found that ewes which were dry as two-tooths were just as likely to lamb as four-tooths as those which had lambed as two-tooths. On the other hand, both Barton (1947) and Wallace (1958) found that the later performance of dry two-tooths was distinctly poorer than those which had lambs. To reconcile these results, Wallace (1958) suggested that one could think of dry two-tooths as being of three kinds: (1) infertile, (2) inherently poorly fertile, and (3) temporarily infertile because of environmental and management effects. The first group will have no lambs at later lambings; the second group will have poorer performance than those which had lambs as two-tooths and, in general, the third group will perform as well as those which lambed as two-tooths. It appears that the last group will represent a large proportion of the total dry two-tooths when on average the two-tooths are poorly grown at tupping. In these circumstances, the percentage of dry two-tooths is also likely to be large.

This picture is further complicated by differences between ewes which are born as singles and those which are born as twins. Again, a number of studies of this difference has been made. The situation, as it appears from studies made on flocks run under differing conditions at Massey University College can be summarized in the following way:

(1) Under poor hill-country conditions, the ewe born as a twin has a poorer lambing performance, as a two-tooth, than the ewe born as a single, although her performance at later lambings is better. Under these conditions, it is common to find that at tupping the twin-born two-tooth ewe is still smaller on average than the single-born ewe — *i.e.*, she has not yet overcome the handicap of being born and reared as a twin.

(2) Under better conditions, it has been found that the ewe born as a twin has on average the same weight as the ewe born as a single at tupping. In this case, there is usually little difference between the lambing performance of the two types of ewe.

(3) Under good conditions, the twin-born ewe can overcome its handicap at less than 12 months of age and,

in these circumstances, it is usual to find that the twin-born ewes have on average a better two-tooth lambing percentage than the single-born ewes.

Thus, it is apparent that the decision as to whether the dry two-tooth should be kept or culled, must vary from flock to flock. The summary given above, however, would suggest the following courses of action:

(a) Where the two-tooths are poorly grown and the proportion dry is large, *either* retain them all and cull only those which are dry as four-tooths, *or* cull the ewes which were born as singles and retain those which were born as twins. The latter method seems to be preferable, especially in a flock where emphasis is being placed on breeding for higher fertility.

(b) Where the two-tooths are adequately grown and only a small proportion are dry, then cull all the drys. On the basis of the statement by T. D. Quinlivan that only 15.8% of two-tooths used in the stud flocks in his survey were under 100 lb liveweight at tupping, one would suggest that dry two-tooth ewes should be culled from stud flocks.

It would appear reasonable that dry ewes at older ages should be culled as well, although there is little information on this point.

OTHER POSSIBILITIES

In this discussion of ewe selection, it has been assumed that the age composition of the flock is normal. There are, however, a variety of ways which can be used for ewe selection which result in some distortion of the age composition of the flock. For example, one could put all, or a much higher-than-normal number of two-tooth ewes into the flock and let them have one or more lambings before culling takes place. No detailed information is available yet to compare the efficiency of this practice with the more usual method.

Selection for Lamb Production in Commercial Flocks

Selection of Rams

To the sheepfarmer who is keen on improving the lamb production of his flock and who appreciates the important part that the ram through his daughters must play in doing so, there seems to be very little to offer in the way of useful information. In purchasing rams, there would appear to be two important points:

(1) Choosing the stud flock from which to purchase. Choosing the stud from which to buy is probably more important than the choice of the ram from within the stud since, in general, the flock ram purchaser will be getting rams which are near the average of the stud. The objective should be to choose a stud where the breeder is consistently endeavouring to breed for higher lamb production.

(2) The purchaser can seek information from the breeder on the performance of the dams of the rams placed in front of him and can use this information to help in his final selection. The point needs to be made that this information will tell much more about the breeding value of the ram for lamb production than any amount of scrutiny in the yards.

Selection of Ewes

The extent to which selection can be practised in the commercial flock depends entirely on whether or not a practical method of identification can be undertaken. In this case, it is not a question of identifying individual ewes but of identifying classes of sheep within the flock that differ in their lamb production potential.

DRY EWES

This is the simplest group to identify from the viewpoint of the work involved, and the usual method adopted is the insertion of coloured ear-tags. The discussion of the dry two-tooth problem given earlier is pertinent here. Two courses of action can be taken. Where the two-tooths are not well grown and there is a large number of them, keep them for a further lambing and cull the twice drys. The main way of improving lambing percentages in these circumstances will be by nutrition rather than by breeding. Where the two-tooths are well grown at tupping, then cull those which are dry.

TWIN LAMBS

Identification of twin ewe lambs by ear-mark is more difficult in terms of the work involved. The fact that a ewe is born as a twin gives two useful pieces of information. First, in selecting two-tooth ewes, it allows emphasis to be placed on selecting twin ewes to enter the flock. Secondly, it indicates that the lamb has had a handicap to overcome and due allowance can be made for this handicap

in assessing what to do about the dry two-tooth ewe. That is, it allows one to retain the dry two-tooth which was born as a twin, while culling the single-born dry two-tooth.

EWES WITH ABOVE-AVERAGE LAMB PRODUCTION

There are various groups of ewes in the flock which will be above-average in their lamb production. Provided these ewes are lambed separately so that it is easy to mark all ewe lambs from them, they can make a positive contribution to raising the production of the flock. For example, if dry ewes are identified by coloured ear-tag, then it is possible to select from among the six-tooth ewes and older, the ewes which carry no tag. One will then have a group of ewes which, as a minimum, will have, at the time they are picked out, reared two lambs in their first two lambings. If the ewe lambs from this group are identified, they can be given preference at the time of selecting two-tooth ewes to enter the flock.

Another elite group of ewes in the flock are the twin-bearing ewes. There is more work in identifying them, but preliminary studies would suggest that there is a substantial advantage in doing so. Ewes which have twins at both two-tooth and four-tooth lambings not only have more lambs later in their own life but also have daughters which are up to 15% better in lambing percentage than those which produce only singles or are dry at these two lambings.

Conclusion

In this paper, the endeavour has been made to summarize the available possibilities for breeding for increased lamb production. An essential point which underlies the discussion but has not been explicitly stated, is that lamb production *is* a character which can be improved by selective breeding. There is good evidence for this, both from New Zealand and overseas. It is also true that dramatic increases in flock lambing percentages are likely to be the exception rather than the rule. Rather, one can expect steady and worthwhile gains from application of some, or all, of the procedures outlined above.

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APPENDIX 1

Selecting for Number of Lambs Reared

The procedure normally adopted by the writer is as follows:

(1) List the two-tooth rams, preferably according to their sire, as in Column 1 in Table 3.

(2) In Column 3 enter the dam's tag number.

(3) Look up the number of lambings the dam has had and the number of lambs she has reared. These have been listed in Column 4 (4/3 means four lambs in three lambings). The index in Column 5 is then found from Table 1. Actually there is no need to include Column 4 because the index can be written down directly from Table 1 as each dam is checked.
The amount of work in looking up the records of the dam is greatly reduced if the ewe records are kept on cards, but the job can still be carried out quite rapidly if the ewe records are kept in an appropriately arranged book.

(4) If it is desired to go a stage further to include the half-sister performance, it is neceessary to sort out the daughters of the sires appearing in Column 2. This is a very rapid process if the ewe cards are punched according to the sire of the ewe.

(5) For each sire, count up the number of daughters mated and the number of lambs produced. In general, it is simplest to use only the two-tooth lambings of the daughters in a given year.

(6) It is necessary to know the two-tooth lambing percentage of the flock in the year in which the daughters have had their lambing.

(7) Calculate for each sire the quantity:
(Factor) × (Daughters' Lambing per cent. – Flock Two-tooth Lambing per cent.),
the factor being read from Table 2 for the number of daughters for the particular sire. Add this quantity to the index in Column 5.

(8) The figures in Column 7 are an assessment of the breeding value of each ram for lamb production, the higher the figure the better the ram. The information is then available for use in the sorting out and selection of the rams in the yards.

TABLE 3: Two-tooth Rams Born 1956

Ram Number (1)	*Sire* (2)	*Dam* (3)	*Dam's Performance* (4)	*Index* (5)	*Half-sister* (6)	*Total* (7)
1	18/53*	20/54	4/3	517	78	595
2		6/53	6/4	543	78	621
3		10/52	7/5	532	78	610
4	21/53†	8/54	2/3	433	—45	388
5		7/53	4/4	471	—45	426
6		2/53	5/4	507	—45	462
7	10/54‡	16/54	4/3	517	—	517
8		17/52	3/4	436	—	436
9		31/52	6/5	500	—	500

* Sire 18/53 was found to have 20 daughters mated producing 22 lambs in their two-tooth lambing. Lambing per cent. is 22/20 = 110%.

† Sire 21/53 was found to have 25 daughters mated producing 20 lambs in their two-tooth lambing. Lambing per cent. is 20/25 = 80%.

‡ Sire 10/54 had no daughters in the flock.

The two-tooth lambing in the flock was 90%.

Sire 18/53: $3.9\ (110-90) = 3.9 \times 20 = +78$.

Sire 21/53: $4.5\ (80-90) = 4.5 \times -10 = -45$.

The factors 3.9 and 4.5 are read from Table 2. The figures 78 and −45 are added to the index in Column 5.

APPENDIX 2

Selecting on Weight of Lamb Weaned

The procedure adopted in selecting on weight of lamb weaned is more complicated. However, as a number of breeders are recording weaning weights, it is worth while outlining the best procedure.

As with number of lambs reared, the dams of the two-tooth rams available for selection will differ in the number of lambings which they have had. As an example, consider two ewes with their records for weight of lambs weaned as set out in Table 4.

In the second column of Table 4 is listed the weight of lamb which each ewe weaned in each of the years in which she has been mated. In the third column of Table 4, the average weight of lamb weaned by all ewes in the flock of the same age in the specified year is given. For example, the average weight of lamb weaned by all two-tooth ewes in the flock in 1960 was 45 lb, while the average for all four-tooth ewes in 1961 was 60 lb. Similarly, with reference to ewe 2, the average weight of lamb weaned by all two-tooths in 1961 was 48 lb.

In the last column of Table 4, the ewe's lamb production is expressed as a difference from the average of the age group to which she belonged in each year. These differences

TABLE 4: Comparison of the Production of Two Ewes

Year (1)	*Weight of Lamb Weaned* (*lb*) (2)	*Average Weight of Lamb Weaned* (*lb*) (3)	*Difference* (*lb*) (4)
EWE 1 (THREE LAMBINGS)			
1960	50	45	+ 5
1961	75	60	+15
1962	60	65	— 5
		Total	+15
		Average	+ 5
EWE 2 (TWO LAMBINGS)			
1961	50	48	+ 2
1962	68	62	+ 6
		Total	+ 8
		Average	+ 4

are then totalled over all her lambings and divided by the number of lambings to obtain the average difference from her contemporaries in the flock. By obtaining the difference in this way, the effects of year and of age of the ewe on the weight of lamb weaned are eliminated.

In the example given above, ewe 1 averages 5 lb above her contemporaries in weight of lamb weaned, while ewe 2 averages 4 lb above. However, these two figures are not directly comparable because the performance of ewe 1 is based on three records, while ewe 2 has had only two records. Thus, the final step is to weight the difference according to the number of lambings the ewe has had. The weighting is done by multiplying the difference by the appropriate factor from Table 5. For example:

Ewe 1 .... $5 \times 0.12 = 0.60$
Ewe 2 .... $4 \times 0.10 = 0.40$

Thus, in comparing two-tooth offspring of these two ewes, the progeny of ewe 1 would be preferred to the progeny of ewe 2.

TABLE 5: Factors for Adjusting for Differing Numbers of Lambings of the Dam

Number of Lambings	*Factor*
1	0.06
2	0.10
3	0.12
4	0.14
5	0.16
6	0.17

DISCUSSION

Q:: *Why is a ewe which produces twins as a two-tooth and a single lamb as a four-tooth better than a ewe producing a single as a two-tooth and twins as a four-tooth?*

A:: The proportion of ewes which produce twins is lower at two-tooth age than a four-tooth age. Hence, the fact that a ewe can produce twins as a two-tooth indicates that her inherited potential for lamb production is higher than is that of a ewe which produces twins as a four-tooth.

Q:: *Should rams be purchased from a flock located under tough conditions rather than from a flock located under more favourable conditions?*

A:: There is no good experimental evidence on this point with sheep. Experience with other animals would suggest, however, that rams should be bred in similar conditions to those in which their offspring are expected to live and produce.

Q:: *Could we not put all dry two-tooth ewes to a Down ram rather than cull them?*

A:: Certainly, if the conditions are such that this is possible.

Q:: *Is there any relationship between face cover and fertility in the Romney ewe?*

A:: Yes. For extensive evidence on this relationship, reference can be made to *Sheepfarming Annuals* 1954, p. 143; 1954, p. 155; 1955, p. 41; 1958, p. 11; 1958, p. 21.

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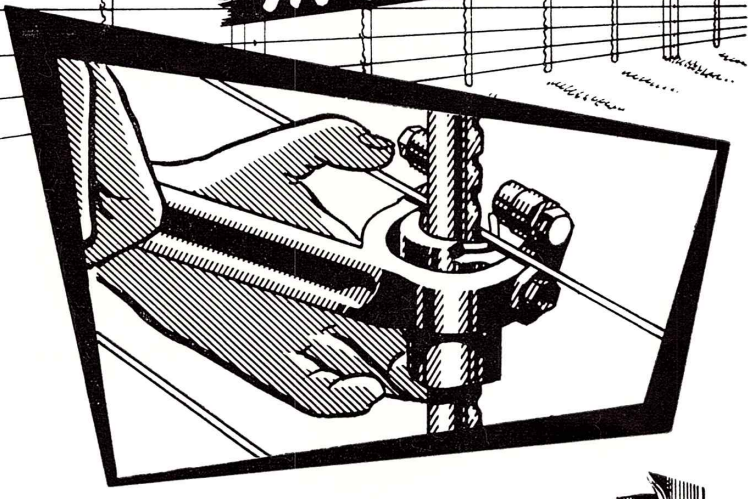

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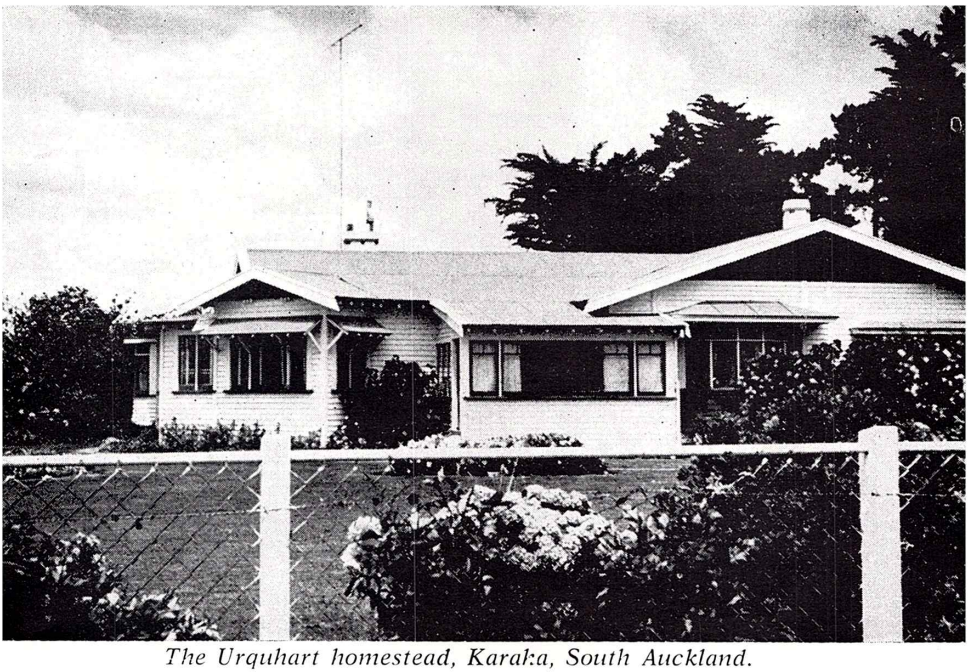


The Urquhart homestead, Karaka, South Auckland.

ONE HUNDRED YEARS OF FARMING IN SOUTH AUCKLAND

E. A. URQUHART*

THE TITLE of this paper may seem to indicate an historical survey of farming in South Auckland, but the intention, in fact, is to show the change that has taken place in the farming of a block of land which has been owned and farmed by one family for 104 years.

Early Settlement

On August 24, 1857, the writer's father left Gravesend, England, for New Zealand on the sailing ship *William Watson*. He arrived in New Plymouth on December 29 after a voyage of 127 days. By the end of this direct voyage, the eggs, bread and vegetables had become a bit stale. It is interesting to think that his son could make the same trip today by Comet in 36 hours.

He started farming at Tataramaki in Taranaki, but after a couple of year the rather hostile attitude of the Maori people there, the quick reversion of cleared land to fern and scrub, and the incessant rain, decided him to move to a kindlier, safer and altogether nicer part of the country.

* *Karaka, Manakau Harbour, Auckland.*

This he found 20 miles south of Auckland at a place called Karaka.

In 1859, he and his brothers bought 1,000 acres of land bordering the lovely Manakau Harbour, a portion of the land being owned by a Highlander named Cameron. Subsequently, the brothers acquired more land in the same area.

At that time the natural cover of the land was fern and scrub. Long before the days of European settlement, the whole countryside was covered with dense, heavy rain forest. Most of this had been burned and destroyed by the various Maori tribes in the district.

The land bought by the Urquhart brothers was undulating to gently rolling. Apart from an area of alluvial land bordering the harbour, the rest was mostly made up of free-draining, loamy soil of volcanic origin. This has been classified by the Soil Bureau of the Department of Scientific and Industrial Research as the Karaka complex.

Although the Karaka district was so close to Auckland, the lack of access except by water 100 years ago put it really in the backblocks. There was practically no one living in the district. The Urquhart brothers had actually bought 1,000 acres of land, but the stock they had in those days could roam over 10,000 acres. At the start of their farming, they ran under 1,000 sheep and less than 100 head of cattle. There were no defined fenced areas and the stock had free range. Life and work were hard and rough.

Thirty years later — in the 80's of last century — things had settled down to some extent. Areas had been enclosed by fencing, though hardly close subdivision as known today, for 1,000 acres was considered a fair sort of paddock. At this time a start was made to put some of the land in permanent pasture, using much the same sort of grasses and clovers are as used today. The day book for the period shows that in 1886 10 acres had been sown down in ryegrass and clover. This paddock has never been disturbed to this day and still produces excellently as a valuable part of the farm.

These same records also tell how tough things were. Grown cattle were worth only £5. Wool fluctuated between 3d and 9d a pound, with sheep at 5s each. Every penny that could be spared had to be ploughed back into the land and, with such poor returns, progress was slow in spite of an immense amount of hard work and hardship. Fertilizers, for instance, such as Peruvian Guano and imported

bone dust, were available at about £9 a ton and had to be very sparingly used because of cost.

The writer's father died in 1899 and the 300 sheep he owned were sold for 3s 4d each. Although prices for farm produce had improved slightly by the turn of the century, following a long period of depression, it was necessary to step up the farm income to keep going and the trustees decided that dairying should be tried. The milking herd was built up to approximately 20 cows — all hand-milked. The milk was hand-separated and the beautifully made butter was delivered in 56 lb casks in Auckland where it was sold for 7d a pound.

Then, after three years of dairying, the incidence of contagious abortion made it impossible to carry on. This was possibly one of the most fortunate things that ever happened. It forced attention to the development of the scrub country. The programme for this was to cut and burn the scrub, plough and fallow the land for 12 months. The crops grown were Algerian oats for horse feed, swedes and soft turnips for cattle and sheep, and Italian ryegrass for seed crops. A small quantity of wheat was grown but the climate was not suitable for it. At this time, an area of approximately 50 acres which had not been cropped was ploughed, fallowed for 18 months, and sown down in permanent pasture. A little of the old-time Bilston basic slag was sown with the grass seed. This 50 acres has never been ploughed since. It is still in permanent pasture and is wintering a grown bullock to the acre today.

By this time the original 10,000 acres of unoccupied land was no longer available. Things had changed and by 1905, the farm occupied 1,700 acres, held in partnership by the writer and a brother. The cropping and development programme was continued for about 10 years. The gradual change from horse to mechanical power started to make cropping uneconomic and the last crop of oats was grown on the farm in 1914.

In 1916 the writer went overseas with the armed forces. About 1,500 breeding ewes and 70 head of cattle were being carried, plus some additional stock on the root crops. The last of the unbroken land on the place was brought in after the writer's return from overseas, when partnership with his brother was dissolved. Since 1927 the whole area has been in permanent grass. Nothing has been ploughed or cropped since that time.

The Farm Today

Compared with the position in 1916 the 1,700 acres is today carrying between 7,000 and 8,000 breeding ewes and approximately 1,100 grown cattle. Everything is fattened on the place.

For the past 36 years everything has been produced from grass. The principle found to be the most practical is to grow the best grass possible and always to follow this up with good stock. The two are completely complementary. Good pasture without stock is of little value, but a combination of the two as practised seems to give a fair return for all that is spent on maintenance. Growing the best pasture and keeping the maximum number of good stock to eat it, means a heavy return of dung and urine back to the pasture, and this cycle, together with clovers and earthworms, plus sunlight, gives the means to grow a continuity of good grass for most of the year to convert into meat and wool.

Very little hay is made. What is made is for what might be called educational value for cattle. Some of the cattle brought on to the farm are by no means docile. But a little hay fed to them is a grand thing to quieten them down.

It should be made quite clear that the type of farming practised suits the land, and fits in well with climate and markets. The absolute necessity for yield per acre is recognized and in as straightforward a manner as possible this is aimed for all the time. But an attempt is made to get that yield with good stock. Further, it is maintained that sympathetic understanding and handling of stock gives good results in weight gain and wool.

Something can now be said of the management of the farm. The paddocks vary a little in size, but average about 30 acres. No pasture is less than 35 years old, and consists mainly of perennial ryegrass and white clover in the autumn, winter and spring, with paspalum coming in from the early summer to mid-autumn period. Cocksfoot was originally sown in the mixture, but will not stand up to the heavy stocking, especially in the sheep paddocks.

The topdressing programme has been rather varied. All kinds of fertilizers have been experimented with, and the clearest picture that could be given would be to say that the pastures were started off originally with basic slag and this has been

Poverty Bay hill country cattle which have been on the Urquhart farm for less than eight months. Their weights averaged 896 lb.

followed with the slag, superphosphate, potash combinations, at about 4 cwt per acre. Practically no straight dressings of lime have been used since experiments with lime at 1 ton per acre were tried without any visible results. It is felt that, with the fairly heavy return of fertility through the stock back to the soil, and with the topdressing that has been used, a reasonable quantity of organic matter has been built up under the pastures. It is felt very strongly that it is the quality rather than the quantity of pasture grown that is the all-important factor. This, plus the knowledge of how and when the pasture should be eaten, is tremendously important. Anyway, this is the conception on which faith has been pinned, and in spite of the moderately heavy stocking, less than 30s worth of drench has had to be used in thirty years. None of the lambs are sold as culls. As mentioned previously, everything is fattened, and that is literally correct, the secret lying principally in the quality of the feed made available to the stock.

As on most other farms, insect pests which can do such fearful costly damage to pastures are present and are being watched. So far, fortunately, they have not given much trouble. Here again, the problem has been given a great deal of thought, with the awareness that in the days when cropping was done — that is, between 1907 and 1917 — grass-grub and army caterpillar damage was very great and sometimes disastrous. There were no insecticides

to use on crops or pastures 50 years ago and losses were often heavy. Since the land has been sown to pasture and stocked, the soil has become more consolidated. This consolidation has been increased by the fairly heavy stocking rate of today. This policy, together with the type of grazing management which is designed to keep the pastures at the stage when they are not harbour areas for the various grubs and caterpillars, seems to have been successful. It is felt that, because of the possible danger from these pasture pests, the type of grazing management to lessen the risk of damage is more important today than it has ever been.

A fairly simple shearing policy is carried out. Except for bought-in two-tooths, the ewe flock is shorn in October. Dipping is done after weaning, which of course is standard practice, and since dieldrin went off the market the swim dip has been used again.

About 2% of rams are used for tupping, which again is standard practice. The sound constitution rams are kept while they are fit for their work. The ewe flock is all mixed-aged Romneys. For many years an attempt has been made to get big-framed, open-faced ewes, with that very desirable quality, the ability to milk, but unfortunately it is being found increasingly difficult to get them. It appears that, by concentrating on wool alone, the milking ability and sometimes the conformation have been sacrificed. The type of ewe which pays the best for prime lamb production is the big-framed, open-faced, broad muzzled type which milks well and can rear a really good lamb or even two. The ewe with wool from muzzle to hocks, and sometimes on the teats as well, is nothing but an unthrifty problem.

Over 100% fat lambs away from their mothers are obtained. Late lambs are fattened on the place and, as mention before, there have never been any cull lambs to get rid of. In this type of farming, as in others, lesses are experienced, but it has been found that, by infusing approximately 20% of two-tooths, the losses are minimized to a great extent. It has also been found that, as the younger sheep become acclimatized, there is less trouble and better percentages. Even the percentage of facial eczema is lessened. The average lambing percentage over the years does not vary a great deal either way. Including 20% of two-tooths, the average ranges between 100 and 110%. In the older groups, this percentage can go up to 130% and better. An interesting point arises out of later tupping. Since the demand for heavy lambs has fallen off, it has been found that this

later tupping results in better lambing percentages. It may be that, when the rams are put out later, the weather is cooler and the pastures better as usually there has been rain enough to bring on the autumn growth.

The farm is now owned by the writer and three sons. These sons are constantly planning and trying out the best ways and means of increasing the efficiency of the running of the property. For instance, the marking of some thousands of lambs is a big undertaking, but a simple method devised for quick tailing has been most effective; with it the lambs can be tailed like "shelling peas". Not only that, the heat from the blow lamp used, seals the wound and prevents blood poisoning.

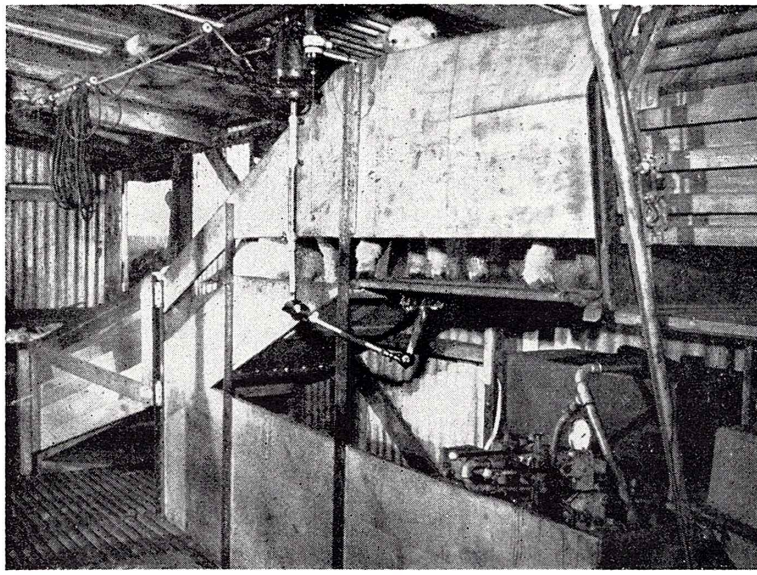
Another recent innovation thought out and planned is a machine for dealing with 12 sheep at a time for foot-rotting, fly crutching and checking mouths and udders. The sheep are simply run up a ramp inside the woolshed to an elevated race. When the race is full, hydraulic oil pressure slightly closes the top bars of the race to hold the sheep in. Then, using the same source of control, the whole race is swung completely over, leaving the 10 or 12 sheep on their backs unable to move and at waist height for easy working. Above the race, on a simple travelling wire, are two electric handpieces — one at each end. These are used for fly crutching or trimming and make for a very quick, clean job. The wool falls on to a clean floor and is easily collected.

When the sheep in this cradle race are finished, the race is mechanically turned towards the floor of the shed where they slide out easily on to a hessian strip and straight into the outside pen. The cradle race is then quickly brought into an upright position ready for the next lot.

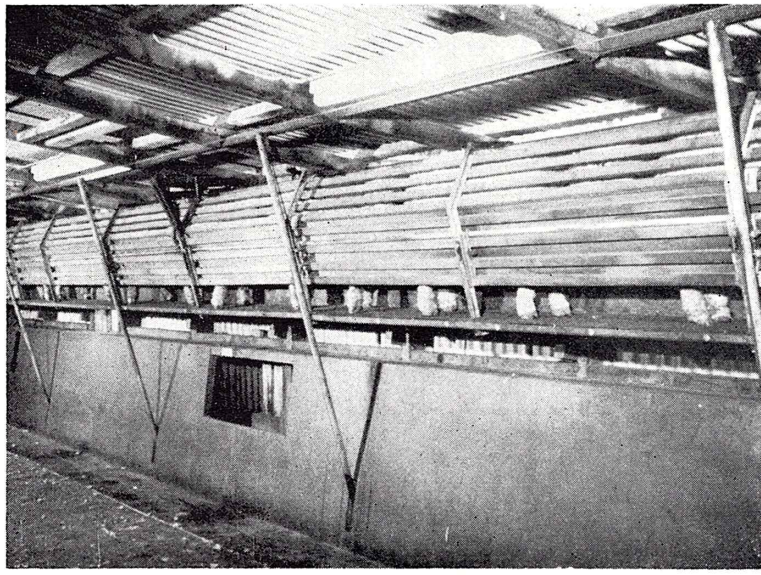
This cradle race has proved a great labour-saver. About 300 sheep can be put through and dealt with in an hour.

As on all farms, there is always the possibility of wet sheep at shearing time. After giving the matter some thought, it was decided that this could be overcome fairly simply. On the western side of the woolshed an addition large enough to hold 150 sheep was built. The base is a concrete floor at ground level. The sides are 3 ft 6 in to 4 ft concrete walls. The floor joists are almost the same level as the catching pens, and on these joists is laid the slatted floor.

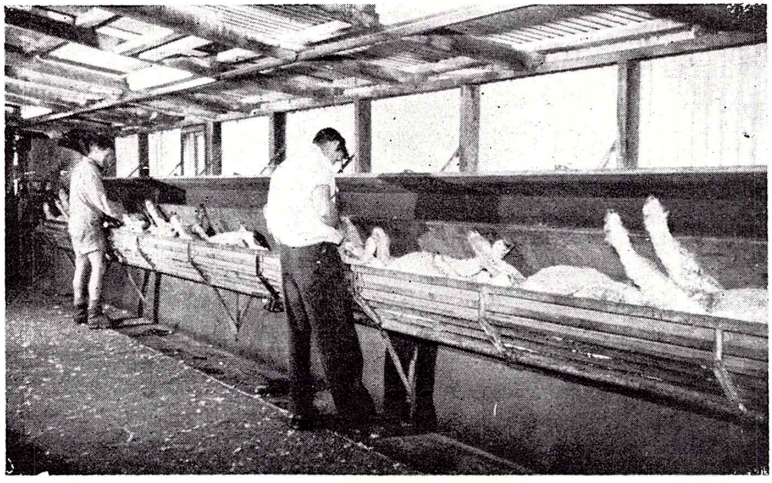
Wet sheep are driven on to this floor. At the northern end of the shed is an American crop dryer, driven by a



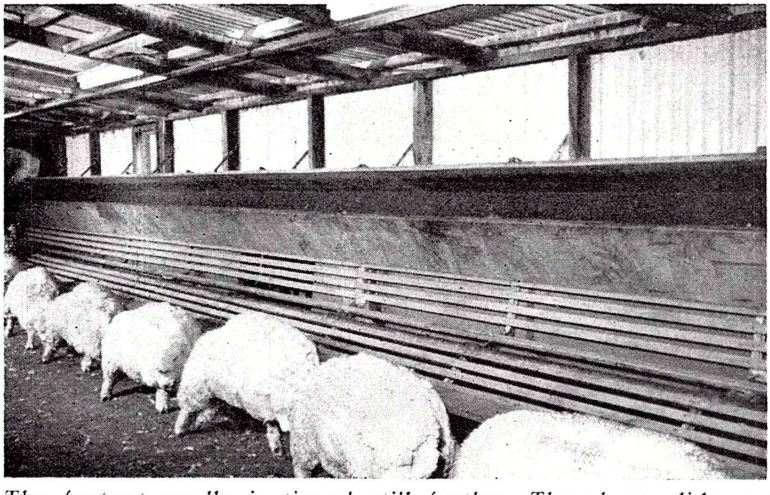
The ramp inside the woolshed leading to the foot-rot cradle.



The foot-rot cradle in upright position along the side of the woolshed. Twelve sheep can be held at one time in this race.



The whole cradle with 12 sheep has been completely inverted by hydraulic pressure. Two operators are shown working on the feet of the sheep, and above them is a travelling handpiece for crutching or trimming the sheep. The wool falls on to a clean floor. Mouths, udders and teats can be quickly checked when the sheep are in this position. The operators work at waist height.



The foot-rot cradle is tipped still further. The sheep slide out comfortably on to a hessian strip on the floor and move directly to a pen outside the shed. The empty cradle is then returned to an upright position, ready for the next. By this method 160 sheep can be dealt with by two men in 20 to 30 minutes depending on how much attention has to be given.

5 h.p. electric motor to drive diesel-heated air through what is called the plenham chamber. The shape of this chamber spreads the flow of hot air under the slats. The hot air rises and dries the sheep. With this machine, in about 30 minutes to an hour, depending on how wet the necks and bellies on the sheep happen to be, this method will dry a mob of 150 ready for shearing. When not in use as a drying pen, the section provides accommodation for 150 sheep for day or night penning.

This unit has a further use. Crutchings can often be damp, but when spread over the slats and given an hour to two hours of warm air treatment, they are ready for bailing.

There is naturally much interest in the liveweight gains of the beef cattle which form an important part of the farm turnover. The old system of buying cattle for fattening has certain difficulties when eye judgement and experience are the main guides to purchasing. So, after giving this matter a good deal of thought, it was decided that the possible risk of getting cattle from slow fattening strains could be minimized by the construction of a weighing platform in the cattle race. This records the liveweight gains of the cattle when regularly run through the race. The possible weakness of this method is fairly obvious for, while the total liveweight gains can be charted, only eye judgement can be used to determine the amount of fat. The actual yield is, of course, decided on the hooks. But in spite of this, it may be found that this simple system of regular weighing — plus eye judgement — may prove valuable after it has been tried long enough to perfect the idea. In the absence of progeny testing on beef cattle, other than that done by the research stations, it is felt that any method which leads to a better feed consumption-liveweight gain relationship, is valuable.

DISCUSSION

Q:: *Could you please outline your speedy technique for docking lambs?*

A:: We use a simple gas- or white spirit-heated searing iron operated by the holder of the lambs. This most useful appliance was thought out and constructed by one of my sons. The principle briefly is as follows: The operator picks up a lamb and seats it on a hinged platform below the searing iron. A slight downward pressure raises the tail on to the searing iron and the tail drops off without the slightest trouble; as I told you, it is like "shelling peas". There is no blood poisoning using this extremely simple and effective outfit. It is light and easy to move from one place to another and can be quickly fixed on to hurdles or docking pens by a thumbscrew underneath the platform.

Q:: *Would the speaker elaborate on his views on the problem of facial eczema in his district?*

A:: In commenting on this problem, I was not suggesting that I possess any specialized knowledge regarding facial eczema. That surely is the province of the scientists who have done a wonderful job in finding the cause of the disease. My own experience as a farmer is briefly this: We have handled a fair number of sheep through the years and have experienced several outbreaks of facial eczema in that time. We have observed that sheep which are settled residents of the farm, as it were, well accustomed to their local grazing area, and under our conditions of management, are much less susceptible to facial eczema than any sheep more recently brought on to the farm. This we have found to be a constant factor.

Q:: *What were the age and the weight of the heavyweight steers you fattened?*

A:: These Poverty Bay hill country cattle (illustrated on p. 189) ranged in age up to rising 4-year-old. They were actually on my farm for less than 8 months. The average weight of these cattle was 896 lb.

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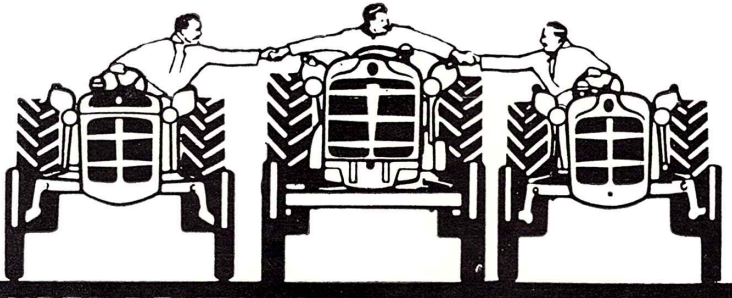

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A PROVIDENT FUND FOR RURAL WORKERS

L. J. CARMODY*

AS EMPLOYERS OF LABOUR, farmers are acutely aware that something must be done to attract men to the industry and to hold them in it. Agriculture is not attracting its share of young men leaving school and college, nor is it holding those already working on farms.

Out of a total New Zealand working force of 919,000, less than 16% (140,000) work on the land. Of this 140,000, approximately 80,000 are self-employed farm owners, leaving about 60,000 employees on wages. A fair proportion of this residue comprises farmers' sons. By 1972 the Government Statistician estimates the working force to be 1,107,000, of which farm labour will comprise less than 12.3%. Conversely, by 1972 twice as many as at present will be working in manufacturing and servicing industries.

The New Zealand labour force is growing at the annual rate of 2.23%. Last year the manufacturing force grew at the rate of 3.4%. Obviously it gained 1.17% at the expense of other occupations, mainly farming.

In the discussion paper, "Prospects for Manufactured Exports", the New Zealand Institute of Economic Research states: "The experience of recent years is that we have a rapidly growing labour force that wants employment in manufacturing and servicing industries. The peoples' personal preferences for living, their skills and education are making them seek an urbanized life despite the close contact of all types that New Zealanders have with the land

* *Abbotsford, Masterton.*

and farming. It is likely that this preference would persist even if material rewards in industry were lower than on farms.

"It is unlikely that employment in primary industry will show any tendency to increase and that all of the increase in the labour force over the next decade will go into manufacturing and servicing industries."

That statement should sober up the optimists in the ranks of farmers. This problem is theirs primarily. They are the people who will suffer most if nothing is done about it. Much of it, of course, is not of their making; this trend is world wide.

But this country lives by the export of grass products. Green grass produced an annual export income well over £300 million as at June, 1963. All the indications are, however, that this figure will be considerably back at the end of the next 12 months.

Yet, on the other hand, it is said that farm production must be increased from the present growth rate of 2.5% to 5% annually in order to finance the increasing demands for imports. New Zealand is at present living beyond her national income to the tune of £50 million, and by 1975 this figure will have grown to £150 million. Obviously external borrowing cannot cater for deficits of such magnitude. Increased exports are the answer. That calls for more men, not less men, on the land and the farmers' problem, and the Government's, is how to induce them to go there.

New Zealand officially knows very little about the true position of farm labour. Details as to personal skills, age distribution, marital status, number and age distribution of dependants, do not exist. Officially, the Departments of Statistics and Labour are responsible for collection of such data, but they have not made a noticeable effort to gain this information. Their figures are very meagre and subject to a lot of assumptions.

Under the heading "Not Otherwise Defined" the Department of Statistics lists 31,770 farm employees. Not much of value in that as a statistical return. Under specified headings, such as Shepherds, Fencers, Shearers, Tractor-drivers, etc., appear only 9,370 of the 60,000 referred to above.

This mass of undigested facts must be reduced to manageable proportions, and a system of incentive benefits selected that will help mould these individuals into a corporate identity.

It is obvious from the number of vacant houses on farms that the real hard core of this labour battalion is not what

it should be. The people farmers mainly depend upon are those living in their houses. The rest, by and large, are not permanently employed, although collectively they are very important.

In the Wairarapa Province alone there is £160,000 worth of capital tied up in vacant houses. Possibly throughout New Zealand £1½ million to £2 million are invested in idle farm houses.

Looking at the so-called permanent employees, there are three main problem phases that should be special fields of investigation if this labour problem is to be tackled actively. One is at the time of marriage, another later in life when the employee's family is at secondary school and possibly leaving home for the town work, and the third is when the father begins to feel he is slowing up and should be looking for something easier.

Although this paper deals with the third phase, the other two have to be looked at very realistically. Otherwise there will be no third phase.

Farming is an attractive way of life to many thousands of New Zealanders. The young men who select it would not change it for anything if they had their way. They work very happily up to the point where they want to get married. Farmers can and do offer these men a good standard of free housing, with meat, milk, firing, and often telephone and electricity thrown in. The pity of it is that the Department of Inland Revenue does not treat employees with the same generosity. The tax on these perquisites should be abolished, and, to encourage farmers to do more for their men, the full cost of such benefits should be an allowable deduction in place of the present nominal deduction. But this is not the main hurdle. By the time the average employee has furnished his house, he is lucky if he has £100 left. The ownership of a reliable car is an absolute necessity to a young couple living some distance from their friends and town. Provision for finance for a car is a "must".

It is not wise for employers to delve into employees' private affairs and it is not recommended that farmers finance cars for employees. Yet if they are left to the tender mercies of the finance companies charging 14% interest rates, the industry suffers the loss of personnel. It is suggested that the State Advances Corporation, which controlled the rehabilitation loans for furniture very efficiently, could also handle this one. With a set of Corporation specifications, inspection, servicing guarantees and group pur-

chasing, a more competitive era for the second-hand car trade would eventuate and employees would get the benefit of personal guidance and assistance in financing and selection of suitable cars.

The next phase is more important still because it covers the period when men are settled into the farming way of life. They have been engaged for ten or fifteen years, and are very reliable, and capable in many cases of running the whole farm.

Here again external factors come into the picture and place these employees at a great disadvantage compared with their friends in town. Once the children pass through primary schooling, the disadvantages of distance from secondary schools, the lack of adequate boarding allowances, the loss of companionship of the children when they go out to work, all place an unfair burden upon the married farm employee and his wife.

This is bad enough but the capitalization of the family benefit legislation aimed a body blow at the farm worker. The Act does not give him equal opportunity to make a deferred deposit on a home. This Act has done more to harm the prospects of rural workers and the farming industry than any other single legislative factor.

It is high time that Government altered it and gave the farm worker his fair share of this cake.

Because a man is happy to live in another man's house outside a built-up area is no reason why he cannot have the benefit of this hedge against inflation. It is no answer to say the farm worker can bank the monthly cheque and save it until he comes to town 15 years later. Constant Government deficit financing nullifies the efforts of any individual to defeat inflation.

There seems to be no reason why farm workers should not have this capitalization placed to their credit in special blocked accounts. Interest should be paid on it and the total made available to farm workers when they subsequently do go into town to live.

If this were followed, the capitalization would be doubled in 14 years at 5% and trebled at middle life. A lot of lip-service is paid to the man on the land for the great job he does in the face of personal inconvenience in all sorts of weather. Suitable recognition could take the tangible form of capitalization of the family benefit as the basis for giving a mortgage-free house to every farm worker in the town of his choice on completion of 25 years of ser-

vice to farming. That should help production and the balance of payments.

The third phase, and the one that intimately concerns this paper, can now be discussed.

Men working on the land, especially on the North Island hill country and high country of the South Island, begin at middle age to feel the inevitable process of slowing up. If a man has been on the job from his youth, the time must come when he has to think of his future in an easier way of life before he becomes too old to be employable in any town position. What applies to hill country applies in varying degrees to other forms of farm life, and, as employers, farmers have to face this fact of a limited working life by employees. The present rate of loss of skilled men at the higher ages is only too evident. The industry can be run successfully if the first and best 25 years of a young man's working life are available. Thus it would be wise to provide for provident fund benefits to mature at this stage, which approximates age 45.

One must accept the findings of the Economic Research Committee in respect to the acceleration of farm labour to the cities under present conditions, but this strong trend can be countered if young men know that there is a substantial cash reward available to them on completion of a specified term of farm work. However, it is necessary to be specific and definite in formulating such promises. The approach is unique. It is the definite planning of a very substantial sum of money at middle life. No other industry gives this and this fact is widely known by employees. Farm employees know that under a superannuation scheme the money is not available until 60 or 65.

Farmers would have a clear advantage if a provident fund scheme were operated which provided a substantial sum of money at the time in life when most people have the heaviest commitments and responsibilities. Farmers have the right to say to constituted authority that 45 is just as much a ceiling age in the farming industry as 60 is in other industries. Men can work elsewhere but not on the farm beyond that age. This is based upon the unanswerable physical facts of hill country life.

All provident and superannuation fund schemes require the approval of the Commissioner of Taxes before the contributions can be made deductible for income tax purposes. This is where the Government alone can help. The Government would have to instruct the Commissioner accordingly, by legislation possibly. The case presented can be rested

upon the facts that, first, a provident fund scheme would be registered, secondly, this benefit is a monetary reward payable at the normal end of the working life of the majority of farm employees, and thirdly, farming is a specialized industry wherein men, rather than machines, produce the results. Just as industrialists are allowed special allowances for obsolescence, so the pastoral industry is entitled to the same recognition of its rights to replace 25 years of constant service with younger men.

To provide a provident fund for employees (which term includes farmers' sons on wages) two parties must be considered. On the one hand are the farmers who employ labour, who may number 20,000 or more. They will of course include every branch of farming and combinations of those branches. On the other hand are the employees who probably number far more. Many of these do remain for long periods with the one employer; others are accustomed to frequent changes. Their duties, working conditions, rates of pay and subsidiary emoluments vary to a remarkable degree.

It is obvious at once that the basis of the scheme could not be a contract between each employee and each employer. Men will continue to serve the industry and continue to move about, although the scheme would have an increasing stabilizing influence upon the rate of such movement. Hence the scheme must still allow for staff movement within the industry. All this rules out the possibility of the scheme being underwritten by the usual agencies such as life insurance institutions or the National Provident Fund.

The industry itself would run the scheme, which would be tailor-made to its requirements. There would be a whole series of advantages in running it in this way from the points of view of economy in management, servicing, interpretation, and future development in benefits, both to employees and the industry.

ADMINISTRATION

Federated Farmers might be selected as the most suitable administrative agency. The Federation is organized upon a national basis. It has the machinery to collect the existing subscriptions of 46,000 farmers. What could be simpler than adding the contributions of employee and employer to the usual annual subscription to the Federation. That collection service alone would save a very large percentage of the normal collection charges made by underwriting agencies, whose charges are as high as 30%. The

Federation has a national chain of organizers and local secretaries capable of giving the responsible personalized service so necessary to success. And as far as the Federation is concerned, it would give it the much-needed stimulus required to enable it to break its present barriers and enter the field of specialized servicing such as exists in Great Britain.

TRUST DEED AND TRUSTEES

Trustees would administer the scheme under the terms set out by a trust deed. The contract would be between the trustees on the one hand and the series of individual employees and employers as set out in the annual schedule of such persons. Every year a new schedule of the contracting parties would be drawn up.

MEMBERSHIP

Membership would be open to every farmer employing labour and to every employee working on farms. A minimum period of one year's probation could be considered; membership would be voluntary. In time this situation might alter to the point where membership could be a condition of employment, but that could only come about as, by a process of elimination, suitable parties on both sides were carefully selected.

Membership would in time materially improve the status of both parties, as records would readily show the worth of employee and employer. A good employer would check with the local agency upon an employee's credentials and vice versa. Though this may appear to be an objection initially, it would ultimately be the greatest benefit arising from the operation of the scheme. Good men have nothing to hide or fear.

Employees who become members of the scheme would retain all their past benefits when they changed their place of work. A change of employer would not affect membership; membership would tend to limit the number of changes.

LIFE INSURANCE BENEFITS

The first benefit provided would be free life insurance providing a death cover from any cause whatsoever. Single men would be provided with an initial cover of £1,000. Married men would be provided with an initial cover of £3,000. These sums assured would be increased

annually by the total of the employees' own contributions, which would be refunded in full on death.

EVIDENCE OF HEALTH

Because of the fairly large number of members in the scheme, the Fund might be expected to experience the normal expectation of life of this community. Therefore the cost of this service could be assessed closely; thus there would be no need to purchase this life cover from a life office; the Fund would annually make an actuarial valuation of its liabilities as soon as it had completed the schedule of membership, and assessed the age-distribution and marital status of members. All medical expenses could be eliminated by making a condition of entry that all employers had to sign a statement that, to the best of their knowledge and belief, the employee or employees working for them were in good health. If otherwise, a questionnaire would be supplied for personal completion.

The cost of this benefit would probably remain fairly constant, as the inflow of younger lives offsets the average age increase of the group. The cost would come out of the employer's subsidy. This death cover would therefore be absolutely free to members and would be a considerable attraction to all married personnel especially, as well as a considerable saving in the necessity to purchase life cover.

CASH LUMP SUM

The second benefit would be provision for a cash lump sum at retirement. This sum would consist of the member's own contributions, plus the employer's subsidy, plus compound interest on both.

The amount would be directly related to the number of years of membership and the annual rate of subscription and subsidy. Provision would be made for these subscriptions to vary up or down and even for some periods when, through hardship, none was payable. Should members join late in life and continue beyond the normal retirement age, the Fund could, if required, offer a retiring pension in place of cash.

RETIREMENT AGE

Members commencing at school-leaving ages such as 17 and upwards would be able to retire at 45 provided they had served the industry 25 years or more. Members joining later would be eligible to retire after the comple-

tion of 25 years of service. Members retiring at 45 after 25 years' service or more would claim as of right the total benefits accrued to their account. The same would apply for all persons serving 25 years but retiring after the age of 25.

CONTRIBUTIONS

Normally, contributions are a percentage of the weekly wage. The wage level would vary greatly. For simplicity of operation and understanding, a flat rate is suggested of 10s. per week to be made by all employees, and employers, with this amount as the minimum, each or both parties to have the right to make further weekly contributions in multiples of 2s. 6d. each.

There would be no upper limit. As employees' contributions are refunded in full in all circumstances on resignation or death, this should encourage long-term compulsory savings.

These contributions must be paid annually in advance. This is absolutely necessary for economy in management and to obtain the desired results from the investment of these funds. Employers wishing to pay additional bonuses into the Fund would do so at the next anniversary of the Fund.

Contributions would be for one year at a time only. There would be no obligation on either party to contribute for an indefinite period of time. Each annual contribution would be a separate and complete transaction in itself.

CONTRIBUTIONS FOR PAST SERVICES

There are very many farmers in New Zealand who have had a long continuity of service from old faithful employees, some of whom are almost family retainers. Many farmers will yield to nobody in New Zealand in the remarkable record of first-class employment they have given. To these, special consideration must be given. It is obvious many of these parties would say the scheme has commenced too late to be of any use, but a special section should be made for them.

If an employer can afford and wishes to do so, he could purchase, by payment of a single lump sum, benefits in addition to the annual purchases. This payment could be made in one sum or in a series of payments and qualify for a special taxation exemption to the employer, and also be tax-free to the employee, provided it was put into the Fund for retirement purposes. This is one of the advantages of having a recognized Fund.

CALCULATION OF BENEFITS

The cost of the life insurance cover would be upon the single-premium basis. This means the cost of the risk would be assessed for each person at his then attained age and for one year only. This would call for the minimum subscription from the employer's subsidy.

The balance of the subsidy, plus all of the member's own subscriptions, would be the corpus of the sum to be invested on his behalf for that particular year. This would be repeated each year. Thus a boy joining at age of 18 and retiring at 45 would retire upon the total of 27 separate annual transactions. This means the whole system is designed to give the maximum flexibility, enabling both parties to join with confidence and subscribe with confidence, knowing their respective liabilities are limited to one year only at a time, and knowing that, if they cannot continue to subscribe, the full benefit of everything already subscribed will be available at the maturing date.

This is how the single-premium method operates.

As stated previously, lump sum benefits would depend upon the number of years of membership, the total of the amounts subscribed, including all special payments by both parties plus compound interest upon both. Obviously the investment folio of the trustees would have a big bearing upon the final result.

Being an internal scheme, with minimum overhead and no servicing liabilities to underwriters, the full benefits of the net interest earnings would be available to each member.

Assuming for purposes of illustration a net interest earnings' rate of 5% and an investment sum of £52 per year per person, the following table indicates the minimum sums available.

Period of Membership (years)	*£52 p.a. Contribution*
20	£1,762
21	£1,903
22	£2,052
23	£2,208
24	£2,371
25	£2,543
26	£2,724
27	£2,913

These sums would be increased by 50% if the weekly combined contribution increased by 10s. and doubled if increased by £1.

Ex gratia payments made for past service benefits, bonuses and compulsory savings, etc., paid in, would with interest materially increase these sums.

WITHDRAWALS

An employee member may withdraw at any time. He would as a minimum receive back the total of all his own contributions plus interest.

He could not rejoin except upon the refund of all his combined withdrawal sums. The employer's normal subsidy is not allowed to be made available to a resigning employee. The Commissioner of Taxes imposes this condition and rightly so to prevent employees receiving a tax-free sum, for all withdrawal benefits are tax free.

The main reason for giving the tax concessions is to make provision for normal retirement — to encourage stability in the industry and to reward those who give continued service. Thus withdrawals should be discouraged. But the trustees should have the right to exercise their discretion as to what *ex gratia* payments may be made on withdrawal, especially after long years of service but before the normal retirement date.

It is suggested that all employees who have reached the age of 40 or given 20 years of service could be given 70% of the employer's available subsidy, increasing yearly up to normal retirement date. Members withdrawing on account of ill health would be treated more generously.

Members withdrawing with lump sum purchases for special past service benefits would be treated as retiring at the normal retirement date. These men would be mature in age at the commencement of the scheme.

These conditions would all have to be decided upon and incorporated in the trust deed and receive the approval of the Commissioner of Taxes.

THE BENEVOLENT FUND

Into this special fund must go all the employers' subsidies not paid out to resigning employees. Generally, all subsidies not being paid out to members resigning would go into this special account.

This benevolent fund must be kept separate from the main Fund and be held in trust for the benefit of all those remaining in the scheme. It would be a substantial one. It

would possibly grow at the rate of £20,000 per year in the early stages. This normally is one of the big reasons for running a scheme internally. The trustees would be empowered to use it for special purposes such as:

(1) Purchase of additional benefits for all members, especially for those who at the commencement of the scheme already had long service with the industry.

(2) Assistance to members incapacitated by illness.

(3) Additional life cover and additional retirement benefits.

(4) *Ex gratia* payments to needy dependants of members.

This covers most of the mechanics of the Fund's operations, and the question of investment of the Fund will not be dealt with other than to say an internal scheme would provide a higher rate of interest than any underwriter could offer. Some comments, however, might be made on the position of self-employed farmers.

SELF-EMPLOYED FARMERS

Section 85 of the Land and Income Tax Act 1955 permits a self-employed person the right to spend up to £250 a year as a deductible item to provide life insurance and superannuation on the life of the taxpayer.

Very few farmers take advantage of the superannuation aspect, having had no personal experience of it. The administrative machinery of this Fund could supply this service. The Act requires that self-employed persons purchase pensions with at least two-thirds of their contributions.

The Fund would be able to offer farmers an unrivalled proposition providing pensions and some cash at any time from age 60 onwards. In addition to that, the Fund could offer life insurance at unbeatable rates. Limited risks of up to £5,000 per person could be taken until the size of membership allowed an increase on this.

This aspect of the Fund's administration would be quite distinct from the main scheme, but in terms of personal service to farmers it would meet with great success. Any man burdened with the worry of death duties, mortgages, young dependants, or faced with the question of distributing his assets among his children, would find these services the answer to many of his problems.

CONCLUSION

Earlier it was said that special approval would be required for the proposed scheme and it was hinted that

it might be necessary to fight for this concession. What is wanted is a provident fund — not a superannuation scheme.

This scheme would have vastly greater appeal if a sum could be made available at middle life. In point of fact, farming is the only occupation that can claim, with demonstrable justification, that the majority of its members leave the industry at middle life to take up some other form of employment; that is, physical reasons compel a change in their mode of employment.

If that is so, for practical purposes that is the normal retirement date. Farmers cannot listen to the argument: "Withhold the money till 60". If they did, their employees could be lumped in with a national scheme sponsored by some Government agency interested in building all rural workers into one vast scheme to lighten the social security burden. This must be resisted. Future farm labour problems are going to be far from easy and the right approach to recruitment of labour must be selected. Whatever is offered as an inducement, it should be such that it will be an unqualified success, distinctive, apposite to the special needs of farmers and if possible something that cannot be matched by others. The scheme outlined contains those ingredients.

Out of the statistical 60,000 farm employees quoted by the Department of Statistics, the scheme could and should start off with the best elements, numbering possibly 10,000. At £52 minimum subscription, the first year's income (gross) would be £520,000. Within 3 years it might be expected that the scheme would be building upon proven lines, namely membership gradually becoming a condition of employment. The withdrawal rate would be dropping and the publicity would be attracting a larger intake of younger men.

The membership should double within five years giving a minimum gross income of £1,000,000, which would be earning £50,000 annually.

The provisions of servicing to self-employed farmers should be successful in attracting a further £300,000, being 6,000 farmers at £50 each. An annual income of £1,500,000 would be within sight in five years. In 10 years there should be £15 million in the Fund.

This would call for a very sound investment programme. It could also provide the farmers with a valuable short-term supply of money. There would be the begin-

nings of the much needed finance corporation heard so much about at farmers' conferences.

Farmers must look this far ahead. Other financial institutions will take up this idea if farmers do not. There is much in it for them, but much more for the farmer, which is why the necessity of running an internal scheme has been stressed.

The key to success lies in the timing of the payment of the incentives. Farmers should not allow themselves to be saddled with superannuation, but pioneer a system based entirely upon the hard realities of their way of life.

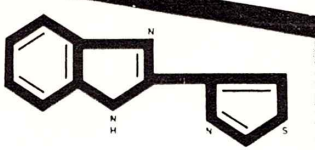
It will be necessary to fight for this break from tradition but once the industry leaders are convinced of the merits of the case, the result should not be in doubt.

The scheme might be summarized as being eminently practical, non-political, built for maximum economy in management and maximum return upon capital invested, and capable of providing sufficient incentives to correct the drift of labour from the industry.

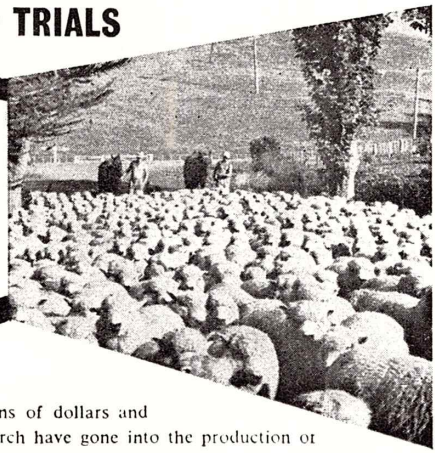
DISCUSSION

Q:: *What is the position, within the scheme, of the ambitious young farmer who changes his job several times with the objective of training himself to become a farm manager?*
A:: Changes of employment do not affect a member's rights. A farm manager is an employee and as such is eligible to be a member. The rate of contribution and subsidy should increase so that his retirement benefit is in proportion to his improved status.
Q:: *What happens to the contributions of the farm worker who at the age of 35 years purchases his own farm?*
A:: Members retiring from the scheme to become farm owners would be treated as having reached legitimate retirement, and would be eligible to receive the total contributions from both parties standing to their names at the actual date of leaving the scheme.
Q:: *Would the scheme be extended to include casual farm workers such as shearers and fencers?*
A:: Casual labour would be included ultimately. Initially they would not, until some experience was gained in the method of collection of the appropriate contributions of both parties. Contractors, whether agricultural or shearing, would be eligible to use the scheme for the benefit of their staffs.
Q:: *How would inflation of the currency affect the value of the funds standing to the credit of contributors?*
A:: The rates of contribution can always be stepped up to offset inflation. Primarily this problem would be determined by the nature of the trustee investments. Investment in equities and freehold properties has received much support from institutional investors for this precise reason. With substantial funds to invest in a wide portfolio, I see no reason why the trustees should not benefit considerably from any inflationary trends in our economy.

PERFECTED IN THE LABORATORY AND PROVED IN FIELD TRIALS



This diagram represents the chemical structure of one molecule of Thiabendazole. **THIBENZOLE** is the Registered Trademark for Thiabendazole.



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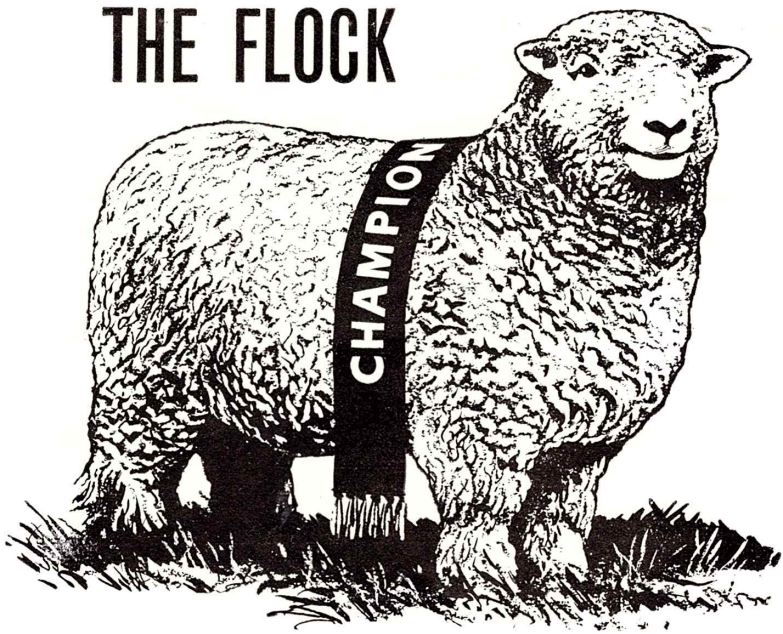

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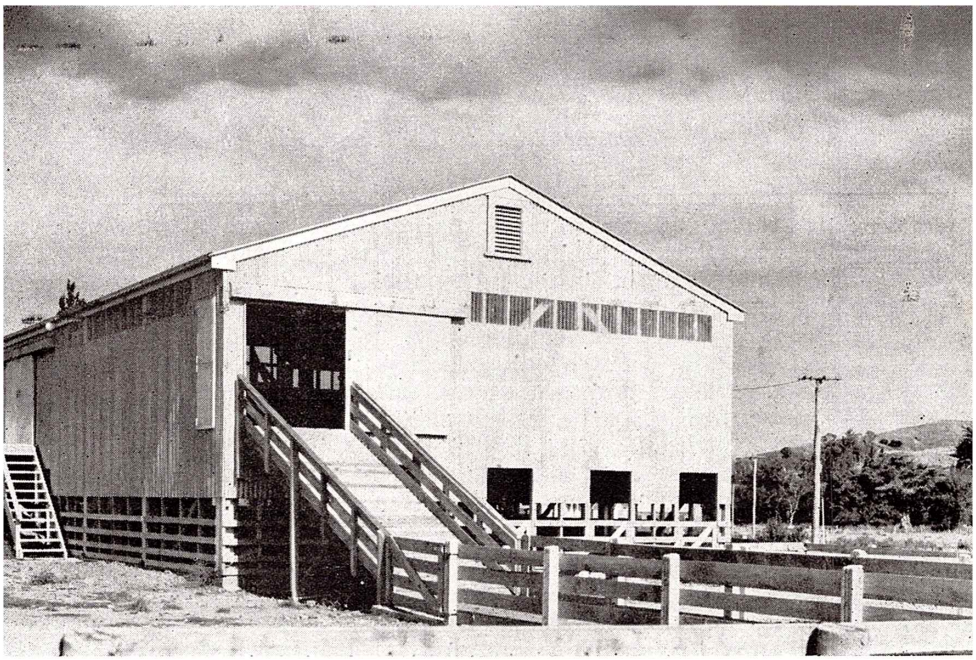


General view of woolshed with full portal framing. Woolroom floor 8 ft 3 in. above ground-level. Obscure lighting strips and all-weather, bird-proof wooden louvres.

WOOLSHED DESIGN AND FUNCTION

R. G. MONTGOMERY*

THERE IS MORE to the design of an efficient woolshed than the construction of a shearing board, a woolroom and an array of sheep pens. Sheep movement, shearing efficiency, wool handling, working facilities and conditions are all interwoven. They must be considered together.

The best woolshed organization comes from intelligent supervision, good design and team-work. Where farmers, shearers, shed-hands and pressers each consider themselves as separate units, they work as a collection of individuals to form a system that does not produce the team-work necessary to efficient handling of good sheep and good wool.

The pioneers built their early shearing sheds to suit blade shearing and it is doubtful if there is another form of building construction where present styles are as close to the originals of 100 years ago as in woolshed design.

In this study of woolshed design and function, the most valuable information came when working with the best

* *Senior Sheep and Wool Instructor, Dept. of Agriculture, Hastings.*

shearers and shed-hands and emphasized that only fast, clean and capable workers give a regular and repeatable working pattern. Unfortunately, farmers designing new woolsheds often take too much advice from people who do not qualify as the best shearers and shed-hands. The best shearers have a rhythmic, easy, flowing style, they and their sheep are always in correct position to complete the work with a minimum of exertion and movement. Conversely, the less experienced shearers can get well out of position without realizing that they have done so, but, unfortunately, they are often the most voluble in giving advice and suggesting alterations to everything but themselves.

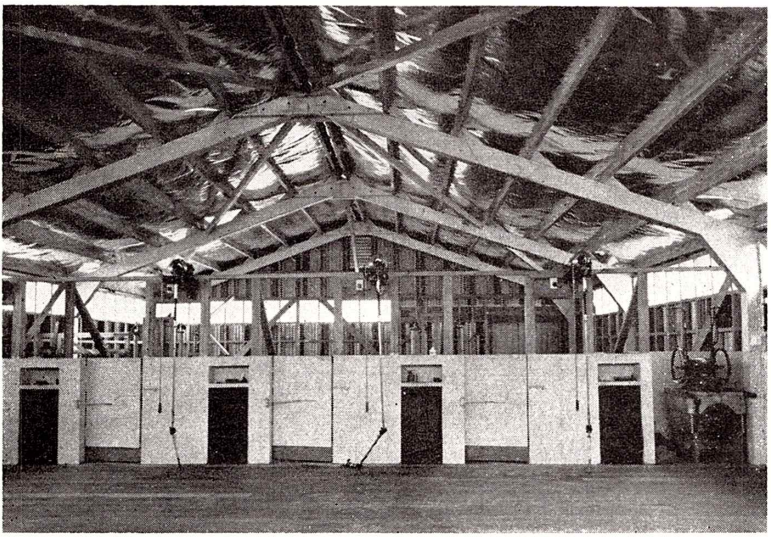
An early part of this study was the cost factor, per 100 sheep shorn: 2-stand sheds were economic where the owner, his family or his regular staff did the work therein, but they become a very doubtful proposition where a shearing contractor is employed. Three-stand sheds were a better proposition; 4-stands gave the lowest cost per 100 sheep shorn under contract conditions, but 5-stands were not so good. Six-stand sheds are costly and awkward, difficult to staff economically and usually "wool-up". Seven-stand sheds are not good, while 8-stand sheds are similar to the 4-stand, provided two wool tables are used.

Placing these sheds in order of economic importance, the 4-stand would be first followed by the 3-stand. Where 2-stand sheds are required, consideration should be given to designing for 3-stands even though only two are actually installed at the time of construction. The 4-stand shed gives the best utilization of labour and the lowest cost per 100 sheep shorn under contract conditions.

Where sheds of more than four stands are contemplated, the property owners should first consider future subdivision of the property and over-capitalization of one particular area. Consideration of possible subdivision 15 to 20 years hence usually makes two strategically placed 4-stand sheds a more economic proposition.

Time Factors

Four average to good shearers can supply the maximum number of good fleeces that can be handled efficiently over one wool table. Four shearers each shearing 200 sheep a day produce 800 fleeces in a 9-hour day, thus one fleece must be completely handled every 40 seconds, irrespective of the style of wool handled.



General view of shearing board. Note open ceiling space and evenness of diffused light reflected from foil ceiling.

With long narrow shearing boards, particularly those over 4-stands, much valuable time that should be expended in workmanship is lost in unnecessary travelling. Long shearing boards of five-, six- and seven-stands are very prone to "woolling-up".

The long shearing board could be reasonably economic for two-, three- or up to four-stands but uneconomic over four stands.

The Raised Shearing Board

The raised shearing board is one where the shearers are working on a slightly higher level than the woolroom floor, usually 14 in. to 26 in. The principle was found to be better in theory than in practice, though many of these sheds are working quite well. The main fault is that, if the shearing board is narrow enough to allow an average shed-hand to lean forward and clear the shearing board quickly, it is too narrow for the peace of mind of many shearers; conversely, if it is wide enough to suit the shearers its handling advantages are usually lost.

Over a full season's work, it is very doubtful if the raised shearing board, with its extra stud height and construction

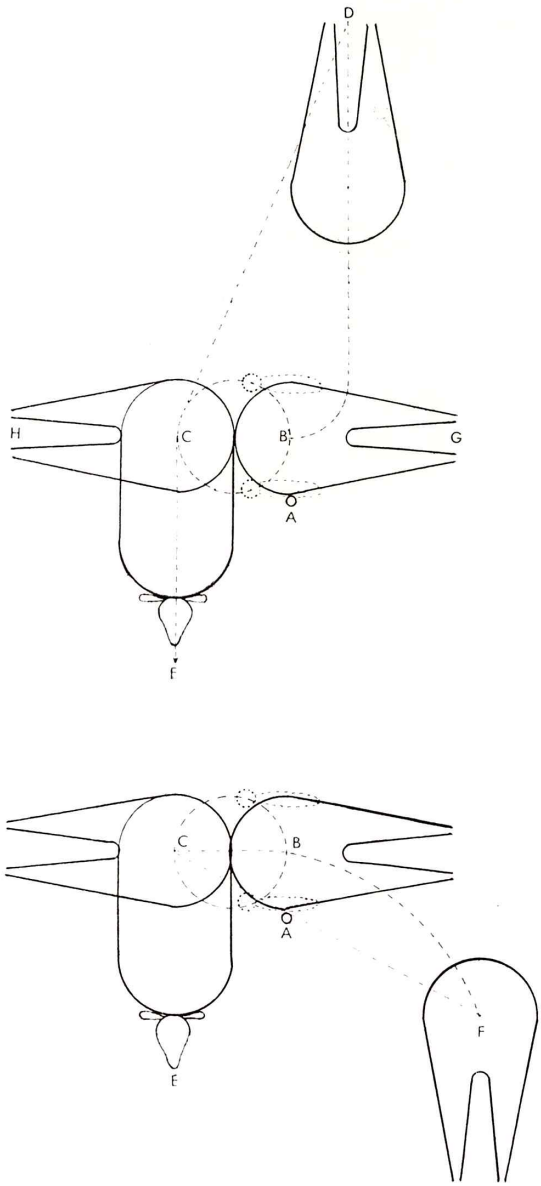


FIG. 1: *Shearing movement diagram.*
A: Shearing machine dropper. B-C: Shearing arc. C-E: Release of shorn sheep. C-D and C-F: Shearer's return for next sheep. G-H; Shearing distance for average Romney.

costs, can show any advantage over the centre board shed with a level floor.

The Centre Board Chute Shed

Where the shearing board is part of the woolroom, construction costs are lower because less square footage is required to accommodate the same number of sheep and shearing stands. This construction necessitates the use of chutes or "return races" to dispose of the shorn sheep. With return races on the same floor level, more building footage is required and sheep movement can become complicated where over three shearing stands are required. Where chutes are used to release the shorn sheep, specialized knowledge and accurate layout are essential for efficient usage. Where the chutes are badly designed, where the shearing machines are suspended too far from the wall, or where the catching pen doors are incorrectly placed in relation to the chute or exit centre, the dispatch of shorn sheep can be awkward. Where these faults have been corrected, the central board ensures minimum of time and labour expended in shearing, handling and transferring wool from the shearing board to the wool table.

The central shearing board layout gives better team work, better general workmanship, can increase the daily output of good shed-hands by 30 fleeces a day and a shearer's tally by 20 to 25 sheep.

Shearing Board Movement Study

An early phase of the time and movement study was to ascertain the space required for each shearer shearing mature sheep. After a shearer has "opened-up" and shorn the belly, he clears the first hind leg and that gives the first extremity of the shearing movement; the other extremity is when the shearer is facing the opposite direction and finishing the last hind leg. In Fig. 1, G to H represent these shearing extremities. With wethers and ewes, the distance between these two points ranged from 68 to 72 in., indicating a bare minimum distance of 6 ft between shearing stands. The distance between shearing stands is directly relative to the width of catching-pens; therefore, to provide convenient width catching-pens, ample shearing space, a safety factor between busy shearers, to prevent big fleeces overlapping, it is recommended that minimum distance between shearing stands be at least 6 ft 6 in. with a preference for 7 ft, to permit the construction of catching-pens with 7 ft centres.

The Shearing Arc

To ascertain the shearing movement, it was decided to ignore existing ideas that could have evolved from the original blade shearing methods. The essentials were a woolly sheep and a shearing machine. The sheep was brought to a fixed machine and shorn with the best result for the least effort. The establishment of a constant shearing arc is fundamental to good woolshed design and this study was complicated until it was found that good, fast shearers, capable of shearing more than 200 sheep a day, give a repeating pattern. Unfortunately, for farmers seeking advice on shearing board layout, there are more shearers

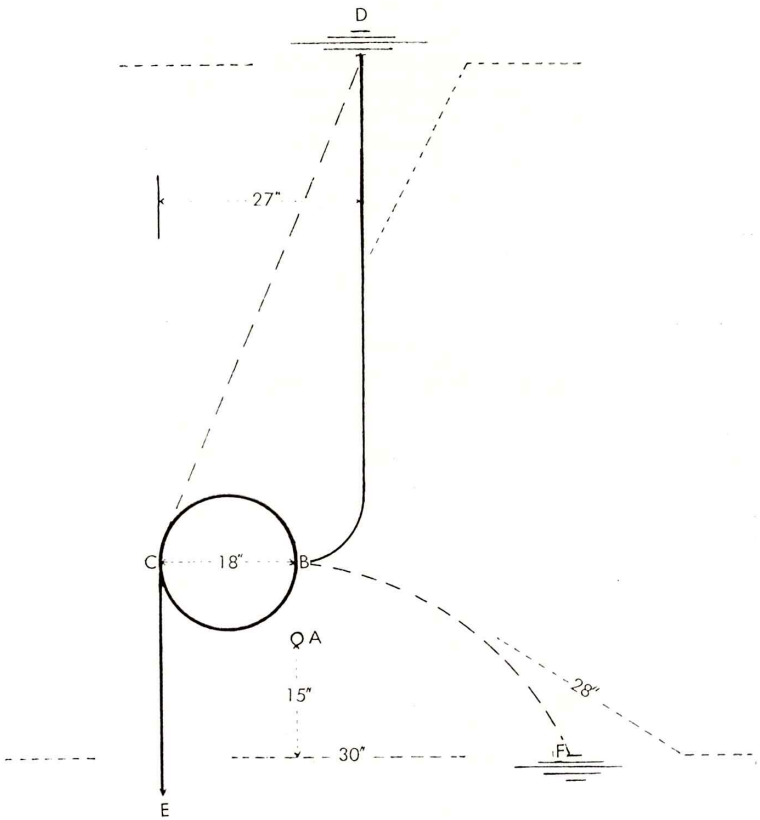


FIG. 2: *Shearing diagram, sheep removed.*
A: Shearing machine dropper. B-C: Shearing arc. D: Centre catching pen doorway, long board. E: Release of shorn sheep. F: Centre catching pen doorway, centre board.

in the lower tally brackets and they appear to give most advice.

When a normal right-hand shearer begins shearing, he is facing along the shearing board with the machines on his right-hand side; he then turns the sheep in relation to the suspended shearing machine "dropper" (A in Fig. 1) until he completes the shearing, when the hind legs will be pointing in the opposite direction to the starting position. For the purpose of this study the movement between these two positions became known as "the shearing arc" (B–C in Fig. 1). With mature sheep, this distance averaged out at 18 in. and became the basic measurement for shearing movement calculations.

Shearing Movement for External Port Woolsheds

After finding the shearing arc, the next study was the movement of sheep from a catching pen to shearing position in the quickest and most efficient manner. This was found to be a direct pull from the catching pen, across the shearing board, with a turn to place the sheep in shearing position, D–B. The actual shearing movements then take up the shearing arc, B–C; the shorn sheep is then released, C–D, and the shearer returns to the catching pen by the shortest and quickest route, C–D, to secure his next sheep.

As each sheep must be brought from the catching pen, that distance should be as short as possible with allowance for free movement of wool handlers. A shearing board width of 7 ft 6 in. was found to be a good, convenient distance on 3- and 4-stand sheds whereas 7 ft could serve in a 2-stand shed.

Shearing Design Principles

For the purpose of this study, it was decided to establish the shearing movement and then build a shearing board around it (Fig. 2). Following this line of reasoning, the shearing machine dropper, A, should be 18 in. from the centre of the "port" or chute. With the long shearing board, the centre of the catching pen doorway should be 27 in. to the left of the "port" centre (Fig. 2).

Shearing Movement for Chute Style Shearing Boards

The shearing arc is constant for all types of woolshed design, but the pull from the catching pen changes with the centre board shed, B to F (Fig. 2).

Where a centre board layout is desired, only one measurement changes and that is the distance from the "chute"

centre to centre of the catching pen doorway. This change is necessary to allow a shearer to back out from his catching pen without tripping over his handpiece, or having to leave his handpiece in an awkward position. The distance from the chute centre to the near side of the catching pen doorway should be 39 in., as that gives the shearer sufficient room to turn and also enables the construction of 7 ft centre catching pens. With shearing machines spaced at 7 ft centres, the shearing board spacings are as shown in Fig. 3.

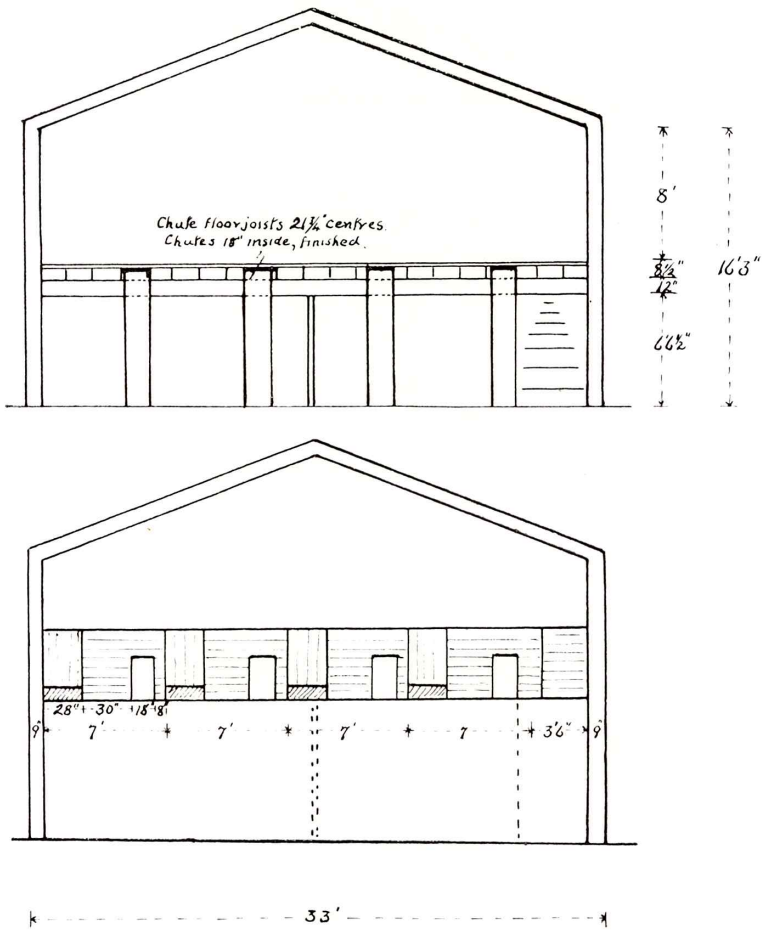
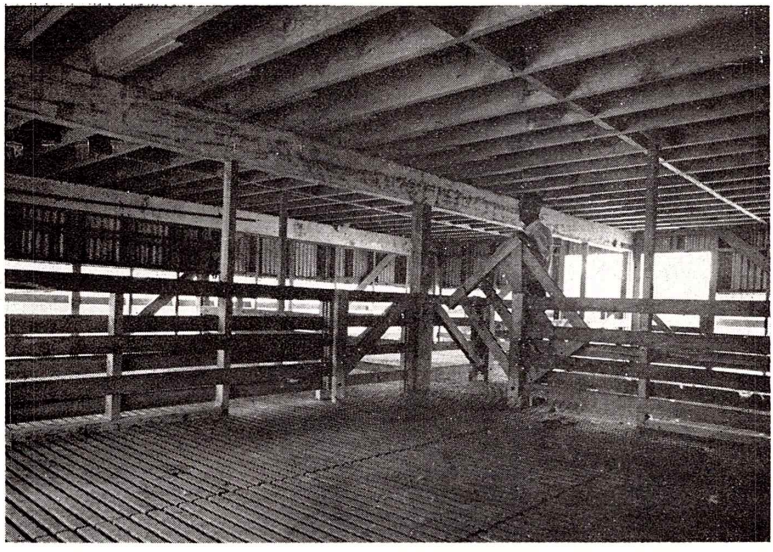


FIG. 3: *Full portal framing, showing shearing board measurements.*



Ground-floor pens. Useful for all-weather sheep work.

Spacing of End Shearing Stand

The extent of the shearing movement is often overlooked in relation to the end shearing stand; that is, the stand at the right-hand end of a shearing board when facing the machines. The end machine is often mounted too near the wall to allow the shearer sufficient room to turn his sheep and shear the last hind leg. The end dropper must be at least 44 in. from the wall; failure to provide this working necessity has spoilt many otherwise good sheds because the end shearer cannot turn his sheep to the finishing position without shearing into the wall.

Shearing Machine Dropper

This study emphasizes that machine shearing develops from and around the "dropper"; that the placement of the dropper is relative to the catching pen doorway and the sheep exit. The dropper should be only as far from the shearing board wall as is necessary to prevent the dropper elbow knocking against the wall; that distance was found to be 15 in.; thus the recommended position for suspending the dropper is 18 in. from the port or chute centre and 15 in. from the wall (see Fig. 2). Where the dropper is further from the wall, the shearing arc is further out on to the

shearing board and the shearer finishes his sheep a few inches further from the wall and port exit. Where a shorn sheep gets to its feet with its eyes inside a well-designed port or chute exit, it goes out easily, whereas an inch or two further inside encourages the sheep to dispute going out.

The physical effort required to heave every sheep those extra inches can take considerable unnecessary labour over a 9-hour day.

Dropper Suspension

The height at which the shearing machine brackets are mounted was found to be relevant to the positioning of the handpiece. It is recommended that the machines be mounted at a height that permits the short tube, or end of dropper — with the handpiece off — to just clear the shearing board floor. Care should be taken to ensure that gut adjustment is correct before checking the height of machine setting.

Where machines are set lower than this recommendation, the end of the short tube will dent the shearing board surface over an area of varying extent leaving unsightly indentations that could be excellent seats for serious shearing board infection.

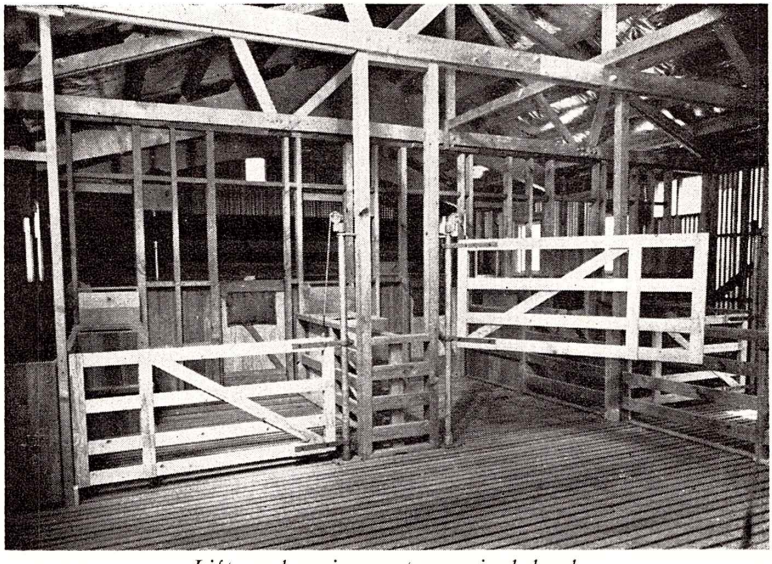
Catching Pens

Each shearing stand should have its own catching pen and these should hold about 15 adult sheep. Convenient small pens 7 ft wide by 8 ft deep, keep a "sheepo" busy, but it is more important to keep the shearer shearing. Shearers are employed to shear sheep speedily and well, not to waste time and energy mustering sheep in big catching pens.

Catching Pen Doors

The type and swing of catching pen doors always creates interesting discussion with sheep men, shearers and shedhands, but this study indicates that the centre of the doorway is relative to the centre of the port or sheep exit and that the door should be hinged as in Fig. 2 to allow the shearer the quickest return to the catching pen for his next sheep.

Doorways should be not less than 26 in. wide; sheds designed by the writer are 28 in. wide. Six- to nine-inch flaps at the bottom of each catching pen door allow the doors to shut quickly over the sheep's feet. The door flap (see Fig. 3) is an essential factor in securing the movement described (see Fig. 2) for the centre board layout.



Lift and swing gates swivel lead.

Lift and Swing Gates

New model lift and swing gates have become standard in shearing sheds designed by the writer. These versatile gates lift with finger-pressure, swing over the number of sheep required in the supporting pen, then are lowered behind the sheep which are "swept" into the catching pen. These gates completely alter the labour situation in keeping sheep up to the shearers.

The gates are made a standard size to fill a 6 ft opening, they are laminated pine, light and tough, and are press glued. The metalwork consists of a 2 in. standard, hinges, counterweight, wire rope and the new type swivel-head.

The counterweight travels up and down inside the standard and does not go below floor level.

These gates are recommended for consideration. They are available wholesale in Hawke's Bay at £7 17s 6d complete, ready for assembly in the woolshed.

Wind-proof Counter-balanced Chutes

Chutes for central shearing boards show an interesting variety of types; some work well, others appear to be actuated by jet propulsion, where the shearer assists the "take-off" and a shorn sheep suddenly lands in a whirl of

dust, crashing into a counting-out pen, injured or uninjured as the laws of chance allot.

The centre board layout necessitates releasing the shorn sheep back through, between or under the catching pens.

The chute should give the shorn or crutched sheep an easy, fast exit without hazard to shearer or sheep. When the shearer is competent enough to finish shearing in the correct position, the sheep enters the chute without objection, slides its front feet down about 3 ft, and depresses the counter-balanced, cleated gangway which swings down to become a ramp; the sheep then walks down on to a fixed "walk-off" ramp which can be any suitable height and length (Fig. 4). As soon as the sheep clears the chute, the

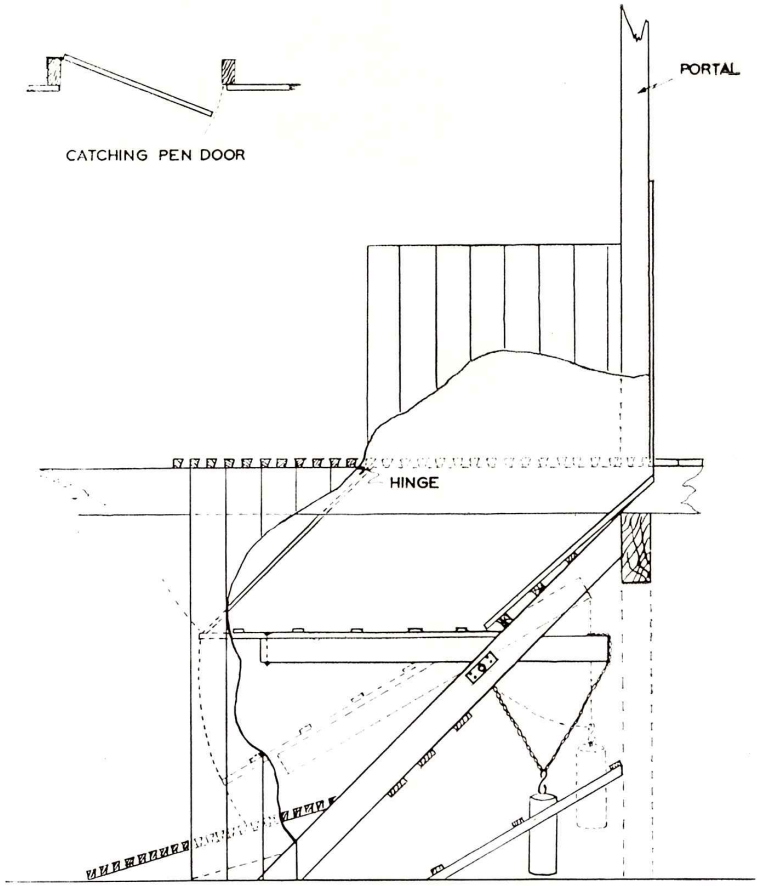


FIG. 4: *Windproof counter-balance chute.*

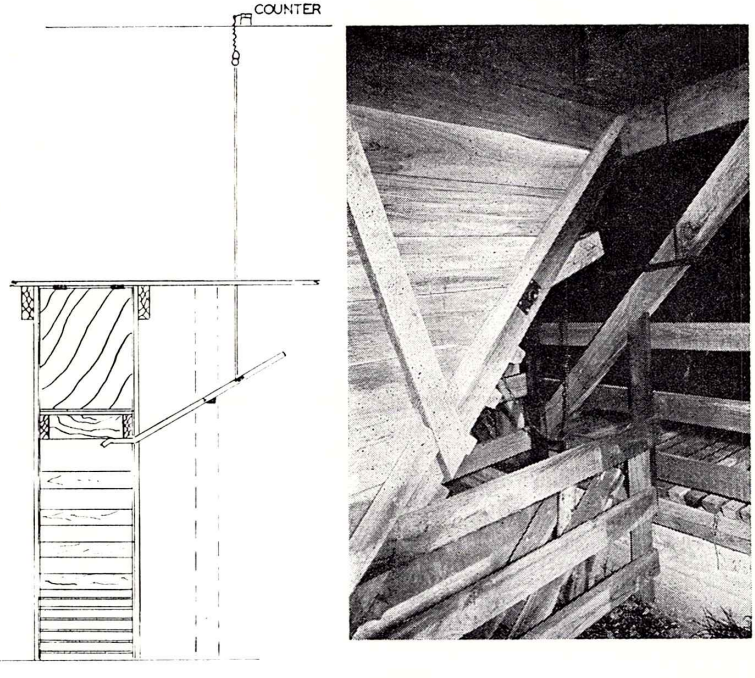


FIG. 5: *Automatic counter linkage.*

gangway rises to close the chute. Where wind up the chute is not a problem, the counter-balance is unnecessary and the chutes can be constructed with fixed gangways.

Counter-balance

Counter-balance chutes are not new but this indirect form gives much safer handling, particularly for "in-lamb" ewes at crutching time.

In the counter-balance system designed by the writer, one end of a light 6 ft galvanized chain is attached to the back of the pivoted gangway, the other end attached to the centre of the axle bar. The counter-weight — in this case 15 lb — is attached to a lower link of the sagging chain. The return action of the gangway can then be adjusted. By changing the point of attachment of the counter-weight a link at a time, it will be found that a full and fast severe return can be obtained; by going the other way, a soft, slow controlled return, to any desired point, can be attained.

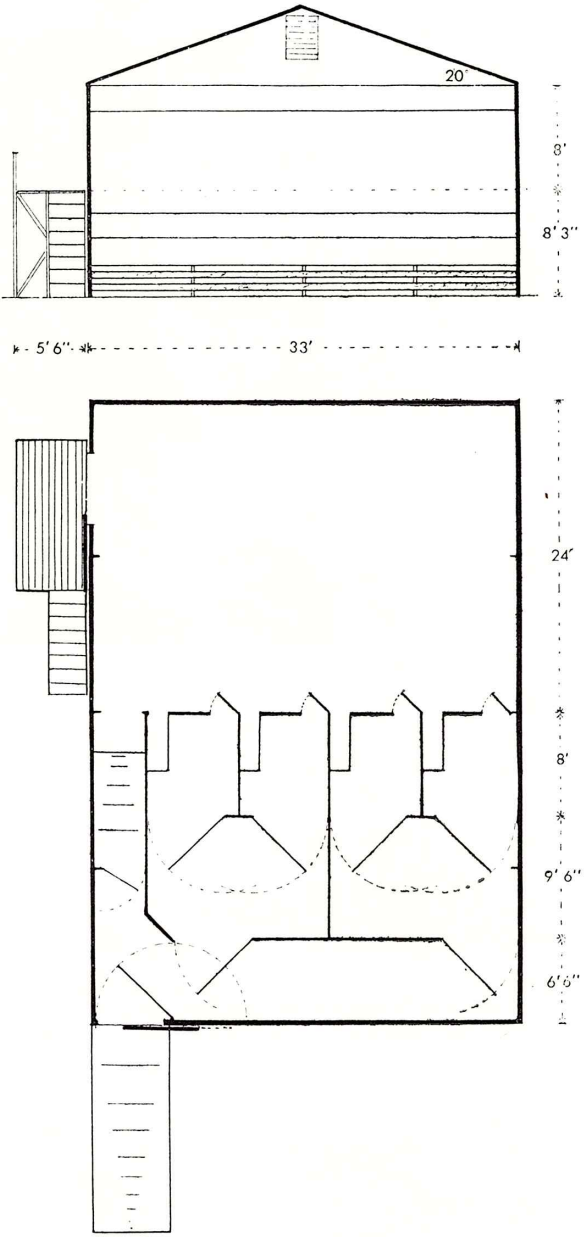


FIG. 6: *Four-stand shearing shed layout with centre board.*

Automatic Shorn Sheep Counter

In recent years, many forms of actuating a reliable sheep counter have been tried and most have failed to stand up to practical test for a reasonable length of time. The simple form described here (Fig. 5) is the result of years of practical work and has been operating since October 1961 under severe test conditions and to date shows no apparent weakness.

Natural Lighting and Insulation

Light from windows and skylights has ruined the work flow in many woolsheds, caused very reluctant sheep movement, bad language, wool room and shearing board labour problems at some hour of the day.

The latest sheds have neither window joinery nor skylights. The cost of providing and flashing skylights and window joinery is put into obscure glass or corrugated plastic sheathing along the tops of the wall. Good quality double-sided aluminium foil is dished 2 in. between purlins, under the roofing. This combination of diffused side lighting and foil ceiling gives an even light over the whole shed, with no temperature extremes. No netting is used under the foil. The use of netting to hold the foil ceiling was found to be a distinct disadvantage.

The double-sided foil acts as a reflector for the diffused light, to spread it evenly over the whole shed and also as an insulator of roof heat. The results of this side lighting and foil combination to date are excellent; sheep, even hoggets and lambs, move freely from any part of the shed to any other part of the shed. The light is excellent, and even, all day; the sheds are cool in summer and warm in winter.

Sheep Gratings

Gratings for night pens, types, sizes, shapes and spacing required are the subject of a present experiment. Eighteen months' experimental work, in practical conditions, indicates that expensively dressed and shaped battens are a very doubtful proposition. Spacing appears to be more important than shape or dressing. Spacings should all be even at ⅝ in. apart.

Experimental work with three different types of gratings in one shed shows interesting results to date. The sheep travelling over these gratings came off alluvial silt loam country, so before too much value is given to these results the experiment is to be repeated with sheep from a sticky clay area.

If the results of two seasons' observations are correct, the expensive, fully dressed and bevelled grating with a rounded top is of no further interest, except for a neat appearance when new and unused.

The cheapest grating used was from mill-sawn timber, approximately 1½ × 1½ in., from a stock mill size of 3 × 1½ in., re-sawn to make two runs of grating. This grating also had the lowest laying charge, carpenters being able to space and fix a much greater area in the same time.

Narrow, flat-surfaced gratings show the best and most economic results to date.

Catching-pen gratings should run parallel to the shearing board as that method supplies the least amount of "pen stain" from the sheep handled.

Structure

Full portal framing allows new concepts of design, including economy of completed structure, uncomplicated by truss specifications in shed width; less ceiling structure and better lighting; allows for better design and layout of the ground floor area, uncomplicated by rows of piles or jack studs; provides an economic method of constructing a shearing and wool floor high enough off the ground to allow better loading of wool bales.

Conclusion

Work on woolshed design and function to date suggests that this subject is a vital one in New Zealand's economy. Better structural ideas are needed; greater use of woolsheds for purposes other than shearing; more lighting studies relative to sheep movement and working conditions; and further studies of working facilities are urgently needed.

Finally, a few pertinent queries: Is a woolshed an expensive convenience or is it an economic necessity? If each farmer had to start farming again tomorrow, how would he appreciate having to use about £3,000 to £4,000 of his valuable initial capital to build a woolshed and shearers' quarters that may be used 20 to 50 days a year? How about the economics of the job? It is obvious that, to show a reasonable return on capital invested, a woolshed must have more uses and be a more convenient farm unit. Should there be a re-examination of the possible uses to which a woolshed could be put? With the form of two-storied structure described, with the top floor sheep grat-

ings screened underneath and the bottom floor completely grated over a washable apron this provides a very useful all-weather sheep working unit, with several other possible uses.

In many cases, particularly where there are teen-age families, a well-designed woolroom can become the social centre of the farm and district and a great relief to the homestead.

The writer questioned a farmer who has one of these newer type sheds and asked "How much do you use your woolshed in an average season?" His instant reply was "About ten times as much as we used the old one. We do more sheep work in the shed because it's quicker and more convenient. The sheep move better. We have all our stock remedies and veterinary appliances stored decently in one place, and that ground floor has also made an excellent all-weather farm workshop with ideal wall storage space for all our farm tools."

Remember a good, well-designed shed costs no more than a bad one.

Good clean conditions normally give good clean workmanship. It is easier to get good labour in a clean, well-designed shed.

On present-day economics, more farmers producing ordinary style wools must handle their clips in their own woolsheds and to save unnecessary and irrecoverable handling charges, design to suit that work is essential.

DISCUSSION

Q:: *How was the spring on the catching pen door fitted, and what happens when the door is wide open?*

A:: One wing of the hinge is fitted on the front of the catching pen door and the other wing securely fastened to the back of the wall stud, thus the door can open only 90°. The principle point is the controlled swing of door, not the type of hinge. Where a catching pen door can swing open past 90° there is a possibility of hitting the next shearer if he is in the finishing position, shearing the last leg.

Q:: *Could Mr Montgomery specify the size of a shed in relation to the size of a flock?*

A:: Woolshed size is not entirely related to flock size. Woolsheds are often more directly related to local circumstances. In the East Coast area of the North Island, where contract shearing is usual, four-stand sheds are most popular. In other areas three-stands are favoured. In many parts of the South Island non-contract areas, two-stand sheds are used. Local labour factors and/or shearing gang circumstances must be considered. Under good stock manage-

ment and for Hawke's Bay climatic conditions, I would recommend that night holding space be limited to enough sheep to provide the first two "runs" in the morning. Large night holding capacity can create a very doubtful sheep health situation, particularly in relation to nutritional checks. I feel that further evidence will emphasize this factor.

Q:: *What is the cost of these sheds?*

A:: Good design gives favourable cost comparisons. I hesitate to put this answer into £ s. d. only because of changing costs in various areas and the danger of creating a false comparison. The shed described was built as it is because the owner wanted the best he could get for the capital available. In other words, the design shown won on its merits against tenders based on other construction.

Q:: *Have patent rights been taken out for the automatic chute, gates and other fittings?*

A:: As a Sheep and Wool Advisory Officer of the Department of Agriculture, my main concern is that our services are available to the farming community. I understand that once these ideas are published nobody can claim patent rights. With publication our original protection is neither necessary nor desirable. There is an improvement to the swivel head of the lift and swing gate that may be protected by patent.

Q:: *Could Mr Montgomery enlarge upon the advantages of the method used to light the shed?*

A:: Lighting studies are very important. I consider the obscure, natural side light reflected from the ceiling to be one of the most important results of our research. With this form of lighting the sheds are brighter, the light is even and good all day; even lambs and hoggets can be moved from any part of the shed to any other part of the shed at any time of the day.

In our early studies skylights were the first to go. Skylights and flashing can be expensive in the country, and to see the first gang in a new shed pushing a man up the outside wall to cover the new skylight with an expensive wool pack hurt both my practical and economic senses! Clear windows with their consequent shadows and difficult sheep movement were the next to suffer by comparison.

The most recent shed has obscure glass panes fitted into top and bottom inexpensive metal channels along the top of each wall. Our plans show all walls done because as designers we do not always know which way a shed will be finally sited. The maximum light advantage in Hawke's Bay comes from just west of north.

From the results of tests to date, I recommend that farmers support a lot more research into structural design and practical fittings with particular emphasis on lighting and animal health.

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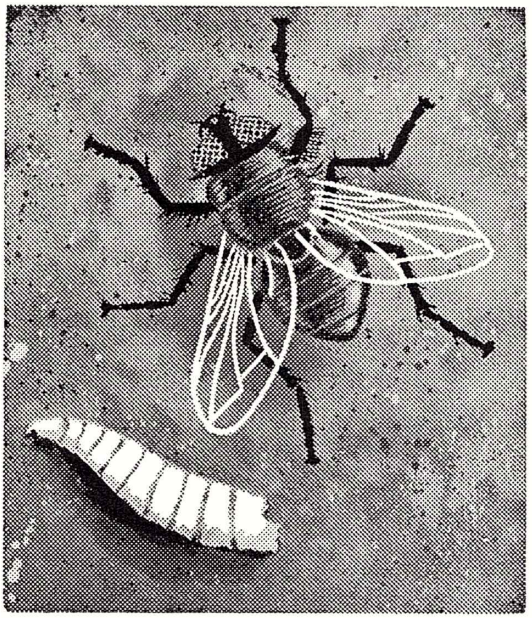

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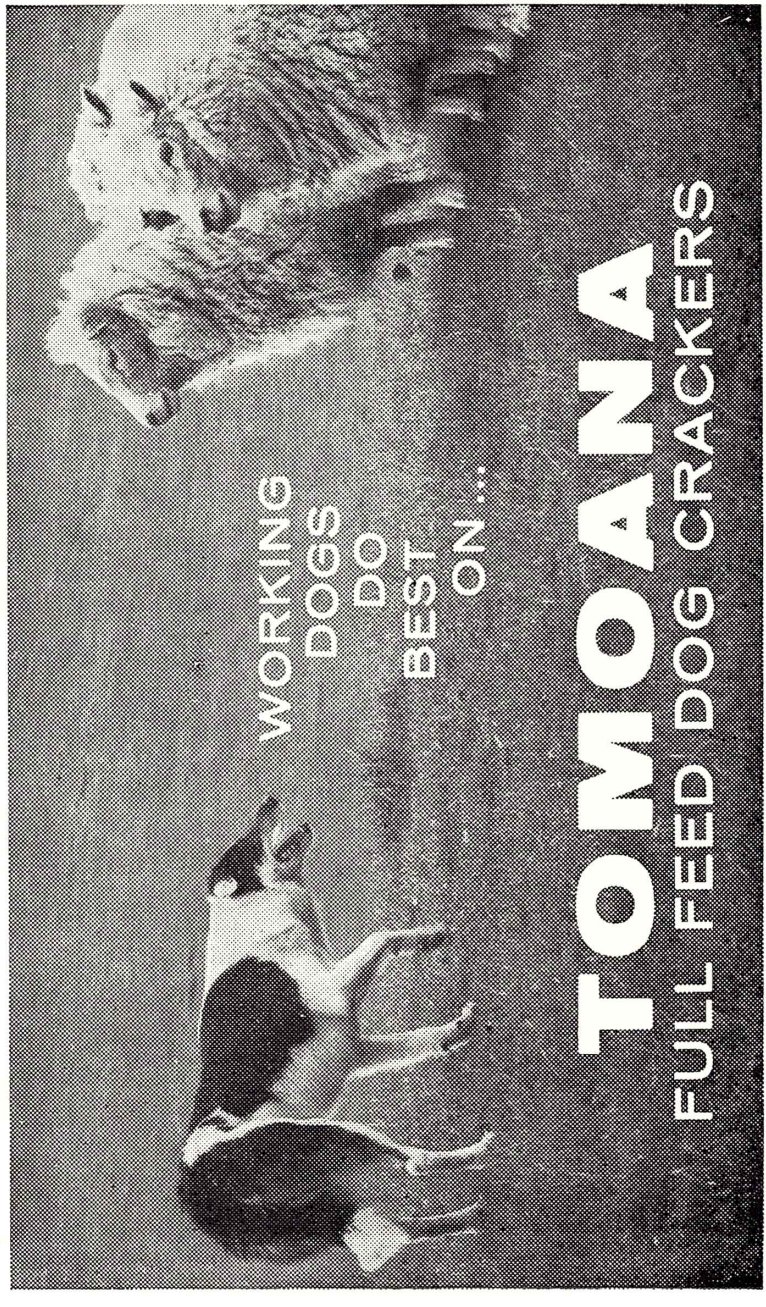
Shell Blowfly Dressing is an entirely new product containing Orthodichlorobenzene and Malathion. These special ingredients drive the maggots from the stricken areas and kill completely while giving protection from re-strike during healing. Special antiseptics promote rapid healing of the affected areas.

SHELL

SHELL AGRICULTURAL CHEMICALS


WORKING
DOGS
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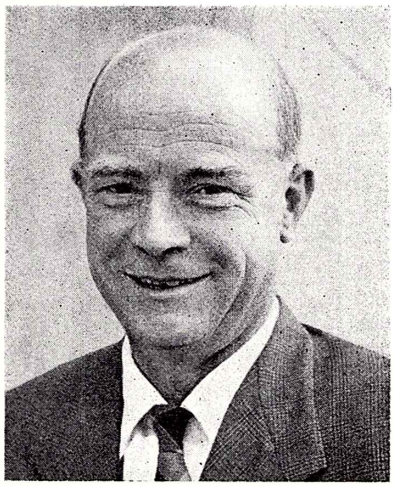
TOMOANA
FULL FEED DOG CRACKERS



The late Dr P. D. Sears, author of the paper printed below, was a forceful advocate of better grassland farming, but the mission to which he dedicated the last few years of his life had a wider scope than the mere mechanics of increasing production from the land. He saw that it was futile to make new techniques and new materials available to farmers unless, at the same time, something was done to create a favourable political and economic environment for farming. He challenged the idea that New Zealand's future lies in industrialization; the concept of farming as a way of life rather than a business; and the system whereby equity investment is channelled almost exclusively into urban industry — and he lost no opportunity to prod us into thinking about these things. His was an evolving theme, to which he brought new arguments and suggestions as his own thinking on it progressed. This paper, given only a few weeks before his death, has a special significance in that it presents in their final form the teachings of a man who will be remembered as one of New Zealand's greatest agricultural missionaries.

CYCLIC PATTERNS
Within New Zealand Grassland Farming

P. D. SEARS*

THE NEED for more agricultural production is so important that New Zealand can no longer afford any delay, nor afford to neglect any avenue or any change in basic thinking towards farming here. More and more people are now recognizing the great need for expanded agriculture in New Zealand but too few yet realize the slow time cycle of the production pattern, nor will enough face up to the need for a rapid change in outlook, if the agricultural machine is to be speeded up in time to avert a real financial crisis.

Elsewhere in this volume (p. 21), H. M. Caselberg gives figures showing the magnitude of the problem and the need to do something about it. Without any criticism of Mr Caselberg, however, the solutions he offers merely traverse the well-worn path of more and cheaper loan capital to

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individual farmers, more concessions, more tax relief, and so on. Likewise, while appreciating the value of his suggested conferences, each year spent talking rather than acting would put New Zealand a further £18 million behind in overseas earnings, on the figures quoted by Mr Caselberg himself. In other words, what he proposes is £18 million worth of talking before there is even a start made on deciding on what action to take!

Progressive increases on a national scale of the order of £18 million per year cannot be achieved at the drop of a hat. Increasing livestock numbers and growing better and more grass and crops, on a national scale, are necessarily a slow process, and, for any worthwhile future success, immediate action is essential.

A few years ago, attention was drawn (Sears, 1960a) to what was considered to be a serious trend in New Zealand grassland farming. This trend, developing at an increasing rate, was due to a flight of capital and labour away from farming to manufacturing and other industries. In that discussion the hypothesis was offered that such flight was inevitable, owing to differences between the financial and operative structures of industry and of agriculture, which in turn acted to draw capital to industry, mainly from the non-farming sectors, but in fact also capital and savings from the farming sector. Some measures were also suggested for recycling such national finance and effort, and thus national influences, back into grassland farming. The reasons for these suggestions stemmed from a belief in New Zealand's great relative natural advantages for high production grassland farming, the great scope in this country for more of such grassland, and also in the increasing world demand for the animal products of such agriculture.

As was not unexpected, the only responses to these efforts were a mixture of derisive laughter from those who believe that grassland farming is not an occupation for other than working farmers; plus, by contrast, more serious outbursts from those who still cherish the social values of the "one-man one-farm" system, and who thus resent any suggestions of larger-scale farm activity, either by individuals or by companies.

Typical of the comments published round this aspect is the following by Ramsay (1962), one of Australia's top administrators, in a recent paper concerning, incidentally, the place of the Public Servant in the community: "As an

example, let me instance one sector of the economy where private drive and initiative is still at its maximum, namely, agriculture. No one but a madman would think of organizing primary production except on the basis of individual people working the land as best they thought fit to maximize their own profit."

He then quotes crop failure in Russia and China as horrible examples against large-scale farming efforts — including presumably large companies, as well as communist organizations.

Business and industrial shareholder interests throughout New Zealand have shown no great response to the ideas presented, except at suggestions that wide-scale farming investment could in its turn lead to lowered protections, and thus profits, from their present investments in secondary industry. However, there was, and possibly still is, plenty of interest in New Zealand farm investment possibilities if the economic climate for such is made more attractive and more stable than at present.

In spite of all this opposition, and indeed perhaps owing to the obvious shallowness of many of the arguments advanced against such equity capital recycling into New Zealand agriculture (even from quite high places), the writer has continued these studies and has been fortunate in being actively joined by two colleagues, K. Williamson and M. J. Roche. Also a few other people now obviously share the view that there is still a vast potential for grassland expansion, but that to really exploit that potential in the changing economic environment, the outlook on farm finance and management will have to be enlarged so as to include modern concepts of capital and labour, as well as technical aids of all kinds.

This attitude is quite different from those who still see a better New Zealand future in expansion of protected secondary manufacturing, but who, in vague generalities, believe and hope that someone will, somehow or other, keep agriculture up to full capacity, not only for home consumption but also provide raw materials from overseas for these other industries.

The writer's feelings in the matter are now even stronger than before, as a result of more recent experience overseas, and thus even more confidence in the expanding needs overseas for New Zealand's agricultural products. There has also been the predicted slowing down in all forms of

New Zealand agriculture, in spite of increasing extension pressure, and plenty of supplies of better plants, animals, fertilizer, and other facilities. By contrast, there has also been the predicted increase of secondary factories such as glassworks, bicycle works, steel, wood screws, and radios, while the nylon factory is under way and no doubt the cotton mill has not been completely lost sight of in all quarters. All these, and others here and in Australia, have gathered their teams of employees and of shareholders, all of whom will, almost surely, help to keep them going on a well-protected basis. Not all farmers have shares in such industries, but that some have is clear from a glance at the names on share registers; in addition, Meat Board data show that the average sheepfarmer has about £2,000 in outside investments, no doubt including shares. There can be no argument with such investments, indeed it is good to spread financial risks, but what must be regretted is the lack of opportunity for people other than farmers to invest in New Zealand agriculture. If they could invest money into New Zealand agriculture this would complete the financial cycle. It would thus, in turn, enable them to share with farmers some of the problems of taxes and death duties from capital increments! Think of all the affluent people who are now given no choice other than to invest in New Zealand and Australian secondary industries. This lack of investment opportunity for the urban investors seems to be a key weakness in the structure of New Zealand's present agricultural industry.

Unless something drastic is done about agriculture and recycling such New Zealand money back into it, there seems no reason for believing that any change will occur from the present now obvious pattern of changeover from agriculture to such secondary and tertiary industries.

That the present economic position is far from happy is, of course, now well known, but not many appear to appreciate the extent of rapid future growth of the problem. In simplified form this is shown in Fig. 1, which has been drawn by Mr Williamson from population and New Zealand consumption data, in the *New Zealand Official Year-book*, and assuming uniform terms of trade. It will need no emphasis here, for it to be appreciated that even to sustain the present state of continued financial crisis, it will be necessary to increase agriculture by a third by 1970 and to double this increase by 1980 — unless of course some manufacturing (and selling) genius starts some other

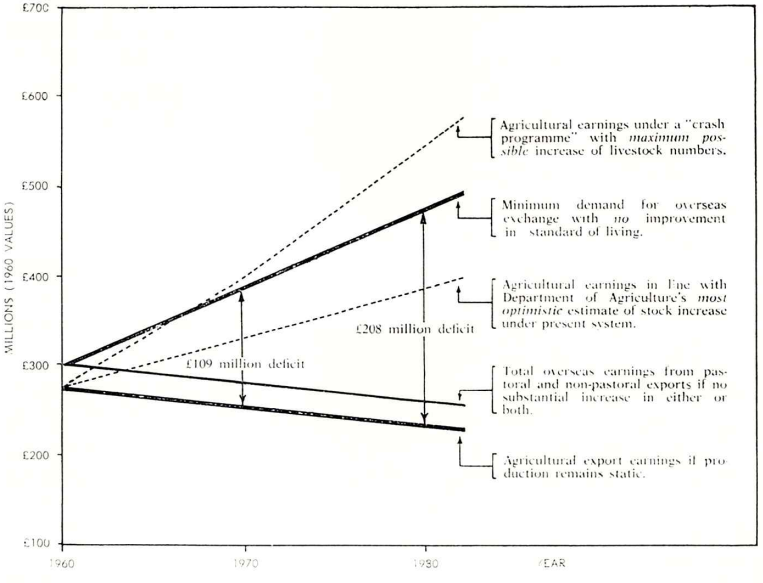
£700
£600
£500
£400
£300
£200
£100
MILLIONS (1960 VALUES)
1960
1970
1980
YEAR
Agricultural earnings under a "crash programme" with *maximum possible* increase of livestock numbers.
Minimum demand for overseas exchange with *no* improvement in standard of living.
Agricultural earnings in line with Department of Agriculture's *most optimistic* estimate of stock increase under present system.
£208 million deficit
£109 million deficit
Total overseas earnings from pastoral and non-pastoral exports if no substantial increase in either or both.
Agricultural export earnings if production remains static.

FIG. 1: *Agricultural production and overseas exchange requirements.*

NOTES: All projections are on the basis of 1960 prices. Secondary industries' contributions to overseas earnings would raise the "minimum demand" line to the extent that their raw materials had to be imported.

industry which can show a like profit on free international trading, in that period.

For the required increase to be gained from agriculture there are, of course, many approaches. Diversity of crops, diversity of processes, and diversity of markets — all have their values, as also does any increase in New Zealand's terms of trade. But even accepting all these, there is still the very large and very obvious scope for more and better New Zealand pastures and animals, and thus more milk, meat and wool and their simple derivatives. The glamour and good points of further New Zealand processing of such products can be appreciated, but the economic value of processing activities is much more doubtful, unless these activities can be done better and cheaper than overseas, and certainly there seems no great need for them while there is still so much unused potential for much more of economic grassland and animal production. The key point in any production programme is surely to further that product which contains the greatest proportion of natural

climatic advantage, and the least proportion of high labour cost, and to complete the cycle by exchanging these goods for their cheapest and best counterparts from other areas.

For such better New Zealand pastures and animals there are, of course, very many important details at all stages, and also differences between districts and farm types. But there appear to be three overriding production cycles which need to be fully appreciated for real progress. These are:

(1) The cycle of pasture growth through soil, clover, mineral fertilizer, grazing animals, earthworms, manure and grass.

(2) The cycle of soil fertility building, and of animal problems through pasture grazing and cropping.

(3) Investment cycles between agriculture and secondary and tertiary industries in the changing social pattern.

The first of these cycles is the important primary background of good pasture growth in New Zealand, the second is good utilization by animals of pasture and crops, and the third the essential economic basis to keep both the first two in full action.

The Soil-Plant-Animal Cycle of New Zealand Pasture Growth

There will be little need to give wide details here, as field evidence and trial data of the value of perennial clovers, mineral fertilizers and animal manure in the pasture economy are widely known and appreciated. Such clover growth and continued outdoor grazing is in wide

TABLE 1: Effects on yields of dry matter (lb/acre) and white clover, mineral fertilizer, nitrogen, and return of

Treatment	Mar.–Sept., 1956 Total DM	% C	% R
NO RETURN:			
Grasses alone + M	500	0	100
Grasses + N + M	1,400	0	96
White clover + M	600	100	0
Grass + Clover	700	14	84
Grass + Clover + M	1,700	52	48
80% RETURN:			
Grass + Clover	600	13	86
Grass + Clover + M	1,700	55	45

M = Mineral fertilizer (P, K, S, Mg)
N = Nitrogen (urea)
DM = Dry Matter
C = Clover

contrast to the difficulties and restricted growth periods in large areas of Europe, America, Japan and the tropics, with their wider range of problem in legume growth, feed conservation and animal housing.

Within New Zealand there is, of course, plenty of variability of soil and climate, calling for different legumes and different stock, but basically farming can operate under a continuing cycle of clover nitrogen, animal grazing and return of manure, and thus associated grass growth, which cycle in turn keeps the feed supply at high level and can also control weed growth, both by animal hooves and by plant competition. Illustrative of such effects are results in Table 1 from a pasture trial which has been running at the Grasslands Division starting on raw subsoil in 1956 (Sears, 1960b). The major influence of white clover on total and on grass production, as well as the increasing influence of mineral fertilizer, and the soil fertility retention effect of the herbage nutrient return, is clearly visible. Also seen is the direct influence of high nitrogen fertilization (about 500 lb of nitrogen per acre per annum, as urea), but, even with this large amount, summer production is low from lack of clovers. Parallel cropping trials on the same soil type have shown equally rapid losses of soil fertility under direct cropping. Such sets of data, taken together and compared with overseas data, show how rapid and how vigorous is the pasture growth cycle in this country. This is not only in total growth but also in seasonal spread of production, particularly with the latest pasture plant varieties.

percentages of white clover, ryegrass and other grasses, of milled herbage — Palmerston North, 1956–62

Oct., 1956–Oct., 1957			*Average next 5 years Oct., 1957–Oct., 1962*			
Total DM	*% C*	*% R*	*Total DM*	*% C*	*% R*	*% OG*
3,100	0	97	1,476	0	69	31
9,600	0	91	10,168	0	82	18
6,700	100	0	8,672	100	0	—
9,200	57	42	9,016	61	28	11
10,100	55	44	11,808	58	37	5
10,000	49	49	12,016	54	36	10
11,200	40	57	13,562	40	53	7

R = Ryegrass
OG = Other Grasses (mainly browntop except in Treatment I where also Chewing's fescue is increasing)

Such simplification is only to give the background of the total good pasture potential. It also takes plenty of care and attention to balance the matter in practice, even on flat country, while the adjustments are even trickier on hilly or otherwise variable country.

The Cycle of Pasture Growth, Soil Fertility and Animal Grazing Problems

Good though overall pasture growth conditions are in New Zealand, and good though the benefits of continued outdoor grazing, there are plenty of associated problems. These range from finding the right clover, grass, and/or mineral deficiency, clover inoculation, grazing for control of light and moisture, effects of pugging, and insects and disease. In fact, many farmers find new pastures are quite disappointing and bring in many problems, not expected, not wanted, and not worth the trouble. This is especially so with the question of animal feeding problems. In an effort to clarify the position Fig. 2 has been prepared. This divides New Zealand pasture into the five broad phases in which the main dominance of certain feeding problems are found.

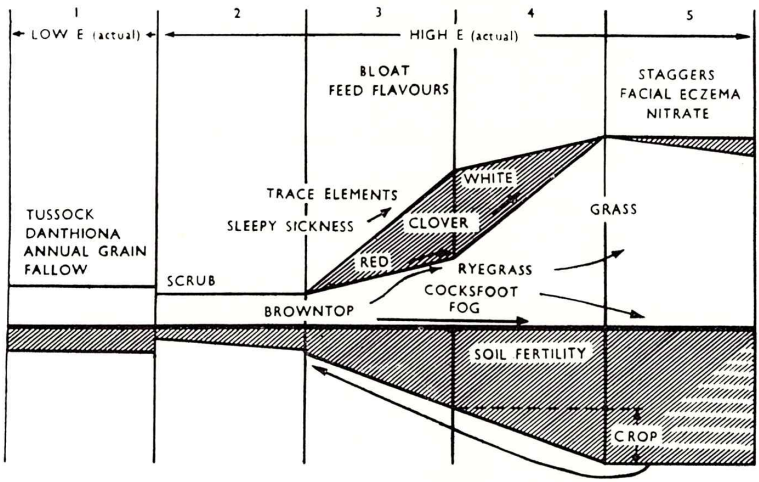

FIG. 2: *Diagrammatic representation of pasture development, soil fertility and occurrence of some animal problems associated with different stages of pasture development. Annual pasture production is shown as height above, and soil fertility as depth below base line. Arrows show trends in amounts of the species, and the arrow below base line shows transfer of nutrients by feeding or soiling of pasture herbage or crop.*

The following are a few notes connected with each phase; the lines shown on the graph show trends, and also the connections by hay, silage, cropping, etc., to balance the cycle between soil fertility, pasture composition and animal feeding.

PHASE 1: *Low productivity grass on land of low actual evapotranspiration due to severe climate, soil type, topography or lack of irrigation.*

The aim here must be to preserve the cover by minimal grazing to maintain balance between erosion and fire hazards. This is not easy in practice because of rapid loss of palatability as leaf and stem increase in age. Grazing control must also include control of rabbits, deer and other pests. Improvement in less severe instances depends on short-season crops, plus appropriate fallow, while the pasture approach is to establish and hold resistant species such as *Danthonia, Phalaris* and cocksfoot, with perhaps an admixture of ryegrass, subterranean, alsike, red clover and lucerne.

PHASE 2: *Low productivity pasture or scrub on low-fertility soil, with a high potential for improvement through drainage, mineral fertilizers, pest and grazing control, and introduction of legumes and, later, more productive grass species.*

Ploughing for land levelling or scrub or weed elimination is an appropriate starting point, but cropping is usually not worth while because of low yields at this stage. Pasture development by oversowing or direct reseeding is more logical. At this unproductive stage, animal troubles appear minimal, owing to low numbers. However, improvement is impossible without rectifying primary nutrient deficiencies in the animal (*e.g.*, cobalt, copper) as well as plant nutrient deficiencies.

PHASE 3: *The improvement from phase 2 to phase 3.*

This involves the development of a pasture dominated by clover until the soil nitrogen is increased, both by underground transfer, and by animal manure, to a point sufficient for grass growth. Such development is not easy. It is essential to apply sufficient mineral fertilizer, not only to promote pasture growth vigorous enough to compete with weeds, but also to provide for the essential increase in soil organic matter. A current example of this can be seen at

the Grasslands Station, Kaikohe. With very heavy initial dressings of lime, phosphate and potash, a vigorous pasture developed after only two years out of scrub and carried some eight ewes and lambs on a weed-free sward; but with only light initial fertilizer applications, the carrying capacity was low (two ewes) and there was considerable re-establishment of scrub and rushes.

On the animal side there are also many difficulties. Because of greater numbers, animal trace-element deficiencies become obvious, while, because of a greater faith in the winter-producing ability of these clover pastures than is warranted, sleepy sickness in ewes becomes a major difficulty. Bloat is prevalent on such clover-dominant pastures, and red clover, subterranean clover and other annuals are all vigorous and even more conspicuous in the pasture than white clover. Feed flavours in milk are also prevalent, as are animal ailments from clovers high in oestrogen content.

It is, however, essential to graze such clover-dominant pature, mainly to obtain the benefit of the turnover of animal manure, but also to prevent shading of grass. Top-dressing should also be continued to provide sufficient minerals for the grasses at the higher nitrogen level. Control of grass-grubs and encouragement of earthworms are important factors in the transformation to a mixed pasture.

Because of the grazing problems on these clover pastures, they are often harvested for silage, or ploughed for cropping, or fertilizer may be withheld. Such action will only perpetuate the situation and crop yields will still be relatively low. The endeavours to evade such early clover problems, by leaving clover out of the mixture, or by sowing very heavy rates of grass, are likewise ineffective. The best method is to get active nitrogen fixation by clover as soon as possible, and for this a light grass seed rate, heavy mineral top dressing, and early grazing control are all essential.

PHASE 4: *Grass and clover with an increasing proportion of grass, and with steadily improving soil fertility and structure through the added nutrients, plant and animal residues, and earthworms.*

There appear to be no animal problems peculiar to this phase, and, given appropriate fertilizers and control of insects and weeds, pasture improvement is relatively easy.

However, much depends on the strains of plants used and their performance under the local conditions. For example, at Palmerston North it has been shown that both H.1 ryegrass and cocksfoot are susceptible to excessive summer defoliation by stock and/or close cutting for silage or hay. By contrast, skilled winter management is needed to hold a balance between ryegrass and clover and to prevent invasion by *Poa trivialis* or Yorkshire fog. On many farms winter stocking does not keep pace with the improvement of pasture by better varieties, drainage and fertilizer. Also, on many farms endeavours to "autumn save" pasture are carried to extremes, and low winter stocking leads to dominance of *Poa trivialis* and Yorkshire fog, which depletes the clover. In general, on such farms the practice has developed of light winter grazing plus heavy summer defoliation, either by cutting or grazing. For most effective development of high production ryegrass and clover, the opposite trend in management is more appropriate — although not so attractive to the eye. A major factor against such lenient summer grazing is lowered palatability, but the latest varieties of ryegrass and cocksfoot offer advantages in this respect. The new machine-choppers for silage, hay and topping also aid considerably.

PHASE 5: *Pastures developed to a high stage of productivity after several years of phase 4, which are probably ryegrass-dominant after continued stocking, and with high soil fertility, particularly in the top layers.*

Productivity is not always satisfactory, however, owing to low summer growth and palatability, particularly of perennial ryegrass, and there are also stock-feeding difficulties from the rapid flushes of growth in the spring and autumn. Staggers, facial eczema and some forms of ill-thrift or mineral imbalance appear to be associated with the rapid ryegrass flush on such areas. Many of the past and present efforts of Grasslands Division are directed towards achieving greater palatability and summer persistence of ryegrass in this high fertility phase, and also towards other direct control of such pasture problems. However, the production of grass seed, hay, or silage, or ploughing for forage or cash crops, offers suitable adjustments. Such cropping will not only produce high yields but also, by lowering the soil nitrogen, will again allow clover growth and establishment of a mixed pasture. The fascinating part of such a programme is the organization of the cropping

phase so that the high soil fertility is utilized without reducing it to such a state that the ensuing pasture has again to develop through the excessive clover of phase 3. Ideally, the crop would be fed out into areas at phase 3 to transfer fertility there, and thus finish up with the whole farm in phase 4.

Within the above classification are several suggestions for best progress through the various pasture phases. The writer is, however, very aware of the many major decisions that have constantly to be considered on the actual farm. Important considerations always in mind in New Zealand include:

(1) The need to maintain clover in the sward in spite of bloat and other difficulties.

(2) The need to maintain adequate leaf cover for maximum photosynthesis, balanced against palatability losses with increase of pasture height.

(3) The need for weed control often calling for grazing more severe than appropriate for good pasture growth.

(4) The practical difficulties attendant upon the typical New Zealand farm having only one class of stock, thus reducing flexibility of grazing, and thereby calling for more mechanical or chemical control of pasture or weeds.

Investment Cycles between Agriculture, and Secondary and Tertiary Industries in the Changing Social Pattern

The case being made so far is to define the extent of the national financial problem, the scope in New Zealand and in her markets for expanded New Zealand primary production, and the great advantages in this country for good pasture growth; although this has the proviso that such high production is not a simple job of easy recipes, but one requiring constant flexibility in dealing with field problems of pasture and animal. Expansion of agriculture also calls for large inputs of capital and labour. In New Zealnd's present economy, it is unrealistic to believe that such inputs will eventuate under the present system of financing farming by loans to single units, no matter how great or how sad are the stories produced. What is needed is to *add* to the best of present farming enterprises the *best* feature of industrial finance. This is essentially to use widespread equity capital. Such in practice, in addition to other advantages, avoids the constant present financial

problems of the individual farmer who automatically limits his capital for expansion, owing to his preoccupation with paying off short- and long-term loans, and who is then finally faced with death duty problems. Also, in a modern democratic system the influential value of widespread equity capital adds up to a considerable pressure group for the particular industry concerned.

With this in mind, and with the single purpose of increasing agricultural output very quickly and with the least disturbance to farmers, the following changes are suggested. The suggestions are made as at least one effort to further the great need for more incentive and new capital into farming. The aim is not only to encourage good farmers to expand efficient production and to replace poor producers, but also to encourage more money, labour and brains into New Zealand agriculture.

(1) Abolish death duties on farm properties.

(2) Abolish taxes on farm income.

(3) In place of the above two forms of farm taxation, introduce an annual tax on the total capital value of each farm. (It is felt that the right to retain everything earned over and above a basic tax would be a greater stimulus to increased production than any of the incentives proposed within the present system.)

(4) Remove absolutely the residential clause in farming.

(5) Remove absolutely the present restriction on land aggregation.

(6) Give the amount at present given to farming as taxation relief on capital expenditure, etc., as direct subsidies on the physical means of extra production, such as fertilizer, fencing, drainage, seeds and also as some sort of subsidy to better attractions to farm labour.

(7) Give to farm companies the same taxation privileges at present given to farmer co-operative factories and to Maori consolidated farming blocks.

It will be seen that these suggestions are designed to remove the sanctity of the "one-man one-farm" policy, to enlarge farming enterprise, and to remove restrictive taxation pressures from eager-beaver farm operators. They would automatically bring down land values, and also make efficient private and company or co-operative farming much more attractive than at present. The suggestions are, however, only of real value if taken as a block, and separ-

ately are of limited value. Indeed, separately they could be of negative value if just added to present procedures.

The challenge facing New Zealand agriculture over the next few decades is one that calls for immediate action. The solution will come from the effective integration of the cycles of pasture growth, animal management, and finance.

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DISCUSSION

Q:: *How do we impress on the powers-that-be the things you suggest?*

A:: It depends on who you consider are the "powers-that-be". Personally, I think that your main effort should be to convince Federated Farmers that their job is to emphasize the whole question of the improvement of New Zealand *farming*, as well as assistance to New Zealand *farmers*. From this there would be extended further interest into other influential circles.

Q:: *Is it not better to convince the people that the problem is urgent?*

A:: I agree it is important that the man in the street should be fully aware of the continuing need for more and better agriculture in New Zealand. But mostly all he hears at present is about individual farmers' problems. It is just as important to tell him about the tremendous potential still available in our countryside — much of what is seen as a nice green pasture is only weeds and rubbish requiring drainage and better grass and more stock.

I think, too, that the average New Zealander would take more interest in improvement of agriculture if he were given a chance to invest, and thus get a more *direct* reward than at present.

Q:: *Can Dr Sears suggest any measures that might be taken to assist young farmers to establish themselves on farms, having regard to the problems of financing and the effects of taxation?*

A:: No one has more sympathy with the struggling young farmer than I, but I think that New Zealand is rapidly running out of being able to afford the luxury of relying *only* on such farming methods. Why cannot we add to our present small farming outlook, the set-up which could use many more young (and older) people in good employment as managers. If we really want to encourage agriculture in New Zealand, I think we have to cut out a lot of sentimentality and start using proper business attitudes and methods, both as regards capital supply and also employment conditions.

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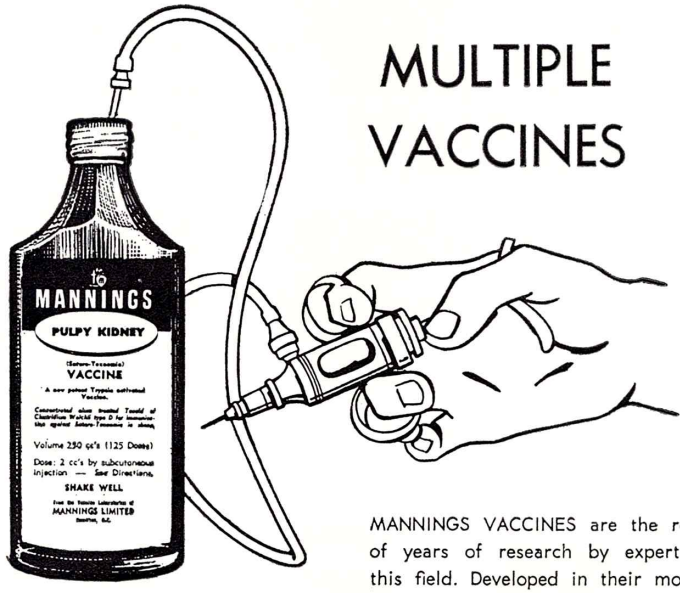

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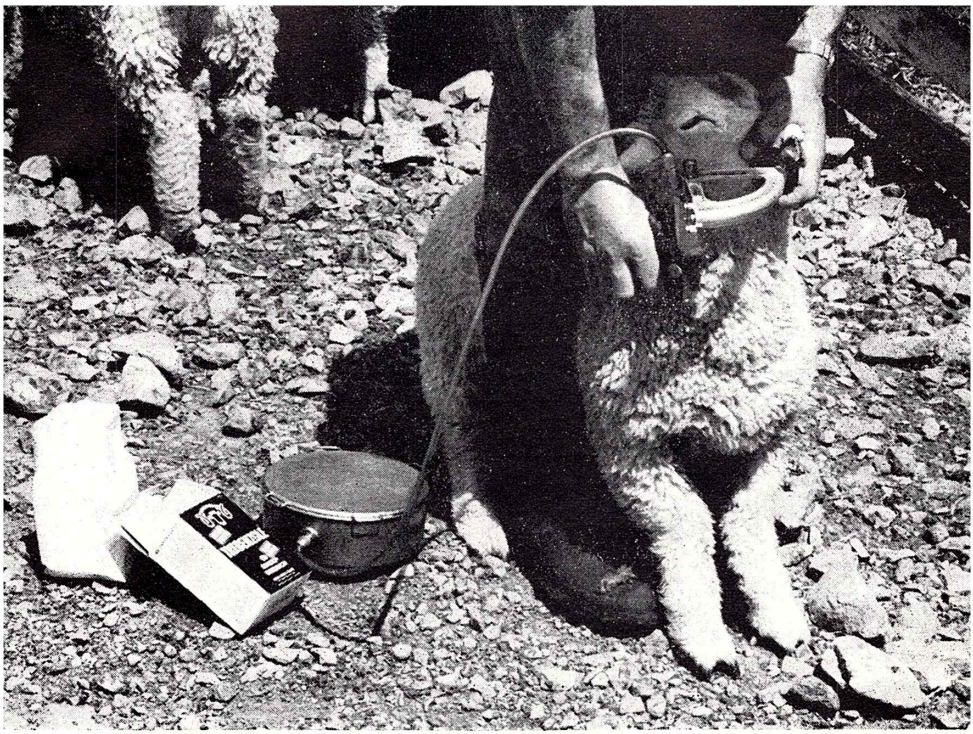

FIELD EXPERIMENTS WITH THE NEW WORM DRENCH THIABENDAZOLE

L. K. WHITTEN*

EXPERIMENTS carried out at the Wallaceville Animal Research Station during recent years have been directed towards the evaluation of some of the new worm drenches that have come on to the market.

The work has been concentrated mainly on determining which parasites are susceptible to the drug under study, what dose rates are effective, and whether the margin of safety is sufficient to allow wide field use without risk of poisoning.

The ideal drug should be cheap, easy to use, and effective against a wide range of parasites and particularly against the more important harmful species.

No drug, so far, meets all these requirements. However, the results obtained at Wallaceville allow a reasonably accurate assessment of the relative merits of most of the new materials. These results are also in fairly close agreement with those obtained by other workers, both overseas

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and elsewhere in New Zealand, and they show that the best of the new materials is thiabendazole. At this point, however, it might be mentioned in passing that, during the past season, four other materials have been examined which may all come fairly close to thiabendazole in overall efficiency.

It was perfectly clear that the whole question of sheep drenching should be examined critically in the field under a wide range of environmental conditions. With the aid of thiabendazole, the effect of good worm control on health and production, especially in the growing animal, could be measured, and thiabendazole itself could be compared with treatment with fine-particle phenothiazine. It was therefore decided to concentrate first on thiabendazole and phenothiazine rather than attempt a full comparison of the six or eight new drugs.

Post-weaning Experiments

The main effort was directed to a study of treatment of the weaned lamb in the autumn when the levels of worm infestation are undoubtedly highest. In order to cover this critical period, most of the experiments were carried out over the months of March, April and May. They were carried out in all the major sheep-raising districts, by the field officers of the Department of Agriculture; they were mostly on privately owned flocks, but some were on farms run by various Government departments.

The experimental lambs were eartagged, weighed and divided into two or more even groups of at least 32 animals each. Groups were drenched on three occasions with thiabendazole or phenothiazine and one group was left as an untreated control group for comparison. One month after the last treatment, all animals were weighed again and their liveweight gains calculated.

RESULTS

As might be expected, there was a wide range of responses recorded — a reflection of the wide variety of conditions found on the different properties. On some there was no response at all — the dosed animals gaining no more weight than the controls. On a few properties, on the other hand, responses of over 13 lb were recorded. On the remaining properties, responses intermediate between these two extremes, with an overall average of 7½ lb, were obtained. This figure is a reasonably accurate one since it is the average of 37 different trials.

In a similar manner, fine-particle phenothiazine gave responses ranging from zero to 11 lb but in this case the average was somewhat lower — about 5 lb. This figure also is fairly reliable as it is the average of 67 different trials.

DISCUSSION

These results should be of some interest to the stud breeder whose aim is maximum growth in his young stock; to the prime lamb breeder who fails to draft all his lambs at weaning time and who must carry a proportion of them on to be fattened later; and to the man who buys store lambs to be fattened either on pasture or forage crops. They should be of greatest interest, however, to the breeder raising his own ewe lambs for flock replacements. It is in these sheep that parasites are most likely to be serious and a contributory cause of ill-thrift and mortality over the autumn and winter months.

Pre-weaning Experiments

A similar series of trials was carried out on lambs still on their mothers. Usually only two treatments were given, one when the lambs were about three months old and one a month later. Final weights were usually taken at weaning time or a little later. In some of the trials, comparisons were made with other drenches, particularly phenothiazine and Frantin.

RESULTS

The responses to drenching prior to weaning were much less than those obtained in the post-weaning trials. Although a smaller number of trials were carried out altogether, there were only small differences between the different drenches, the biggest liveweight response was only 5 lb (in this case with Frantin), and the average response was less than 2 lb. Frantin is more effective than thiabendazole against *Nematodirus* and better responses may occur with this parasite if it is the predominant one.

DISCUSSION

These results are probably due to the fact that worm infestation is a relatively small problem in the unweaned lamb and that the worm population is only just beginning to build up towards serious levels at weaning time. Most fat lambs, of course, are slaughtered before the main peak of pasture contamination is reached in the autumn.

TABLE 1: Liveweight Responses to Drenching (in relation to control group)

Time of trial	Pre-weaning		Post-weaning	
Type of drench	Thiabendazole	Frantin	Thiabendazole	Fine-particle Phenothiazine
Number of trials	19	8	37	67
Highest response in any trial (lb)	3.7	5.1	13.4	11.2
Lowest response in any trial (lb)	-1.2	-0.7	0.1	-0.7
Average response over all trials (lb)	1.5	2.4	7.5	5.0

General Discussion

It should be clear from these results that a greater return is likely to be obtained for a given outlay on drench, if this is used in the autumn rather than in the spring and summer.

Over the past season, when thiabendazole was in short supply, the writer believes that much of it was squandered by using it on unweaned lambs when it could have been used more effectively after weaning. The supply position was such that later in the autumn when it might have been used to greater effect, it was even more difficult to obtain.

Drenching of the breeding ewes, though sometimes recommended, has very little sound experimental work to support it. This could be a useful line of enquiry in the future but so far it has not been examined on a sufficient scale. Most experiments carried out so far have failed to show any effect. Under outbreak conditions when heavy infestations occur in lambing or lactating ewes, drenching is undoubtedly useful but as a routine procedure it is still of very dubious value.

An important fact emerging from the data presented is that the results of a single experiment, no matter how carefully conducted, have only limited meaning. If the results are to be applied to the sheep farming industry as a whole, a large series of co-ordinated trials is necessary; help must be given by a large number of people and, of course, the cost is considerable. In the present series, the investigation has been helped by a large number of farmers, some of the drench was supplied free of charge, field officers and others did the physical work of handling the sheep, weighing and drenching them, and the results were analysed by the Biometrics Section of the Department of Agriculture.

For my own part, although I helped to weigh a few sheep — a few of the several thousand that were involved in these experiments — my role is merely that of a spokesman for my many colleagues who actually did the work.

DISCUSSION

Q:: *Would you like to name the other four materials similar in efficiency to thiabendazole?*

A:: Yes, these were:

(1) "Ultramized phenothiazine" — a very fine form of phenothiazine which is already on the New Zealand market in small quantities.

(2) "Loxon" or haloxon which has also just recently come on to the market here.

(3) "Phenovis 2", a mixture of phenothiazine and phenzidole, a compound related to thiabendazole. This will be available possibly next season.

(4) "Bayer S940" is an organophosphate which will also probably be available next season.

Mintic, promintic and montrel were tested the season before last.

Q:: *Do these drugs have any effect on tapeworm and if not did you dose for tapeworm?*

A:: These drugs have no action on tapeworm. In three trials, tapeworm control was attempted in half of each group but responses were small.

Q:: *Were all the lambs dosed at the same rate as recommended?*

A:: Yes, all dose rates were as recommended.

Q:: *Should lambs be starved before treatment?*

A:: No. They should be brought in, drenched and turned straight out again.

Q:: *Would you care to comment on the relative costs of the new drenches and the fact that thiabendazole does not always control* Haemonchus?

A:: Most of the new drugs are fairly competitive in price. Mintic is slightly higher in price and phenothiazine is less than thiabendazole. Our trials showed good control of *Haemonchus* but under outbreak conditions rapid reinfection can take place.

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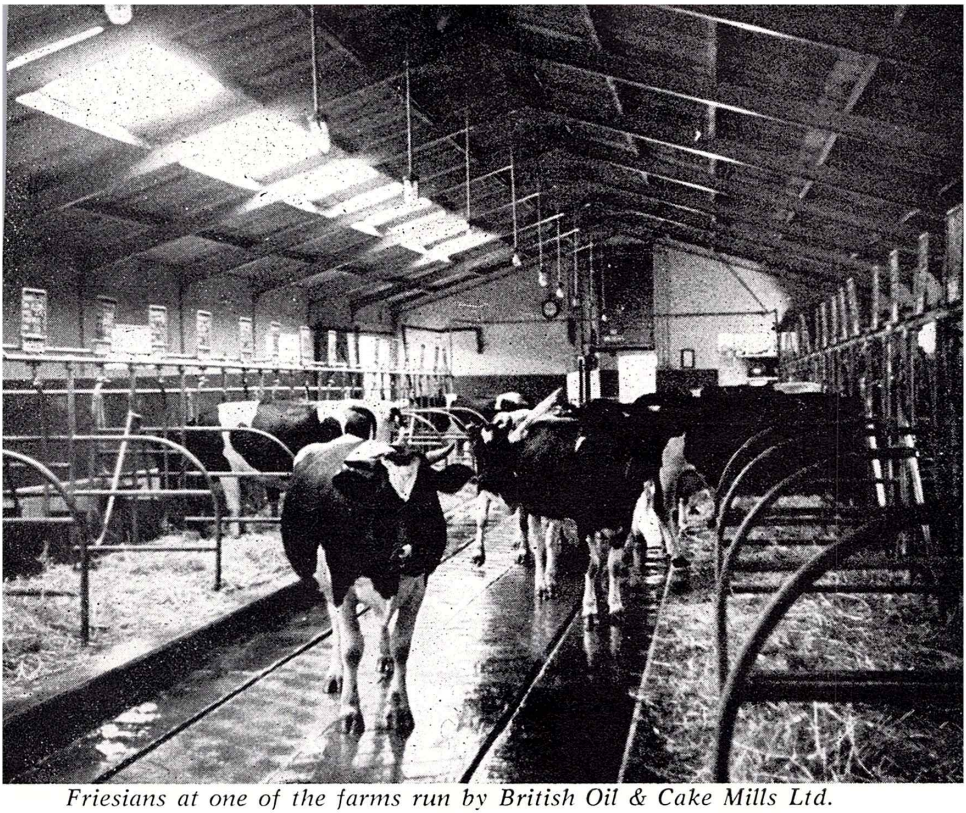

Friesians at one of the farms run by British Oil & Cake Mills Ltd.

COMMENTS ON ANIMAL BREEDING OVERSEAS

A. L. RAE*

LAST YEAR, the writer had the opportunity of studying problems of, and progress in, livestock improvement, during the course of study leave in U.S.A., Great Britain, and in several European countries. In the main, discussion will be devoted to sheep and beef cattle breeding in those countries but reference will be made on occasion to work with other species of farm livestock.

At the beginning of any discussion of animal breeding in other countries, it is important to state certain general considerations. In a programme for the improvement of any breed of livestock, the initial and most important problem is to attempt to define as clearly as possible the objectives in improvement of the breed. In general terms, these objectives will be decided by two factors: first, the economic conditions which control the relative financial

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returns for the products of the animal (meat, milk and wool) and, secondly, the general environmental conditions in which the breed is expected to produce. This second factor decides to what extent the characteristics of hardiness, resistance to disease, etc., have to be part of the programme for improvement. Because these factors vary from country to country and from breed to breed, so also do the objectives in breed improvement. Thus, it is essential, if one is to appreciate critically work on animal breeding overseas, to bear in mind the conditions, both economic and physical, in which the animal is expected to produce. Projects which make sense in one set of conditions can easily be nonsense in other circumstances.

It is also necessary to have some knowledge of the structure of the breeding industry in order to assess the practicability of various breeding plans. For example, one needs to know whether any general pattern of cross-breeding exists in the industry. Is there an organized stud breeding industry? How big are the flocks or herds? There is, for example, very little point in considering progeny testing when most flocks are less than 50 ewes in size. Hence, in looking at animal breeding methods in any country, it is necessary to review briefly the salient features of the livestock industry in order to put the various projects into their appropriate context.

Sheep Breeding in Great Britain

Sheep production in Great Britain is a comparatively important segment of the agricultural industry. Total sheep numbers have increased from a post-war low level of 16.7 million to above 28 million, and there is evidence that the trend is still upward.

The production of fat lambs and wool in Britain is maintained by an integrated system of sheep breeding which involves some 40 or more recognized pure breeds and a number of crosses. The starting point of this stratification is the hill flock which may be any one of a dozen or more breeds. These flocks are bred pure. The surplus and cast-for-age ewes from these flocks are then crossed to rams of breeds such as the Border Leicester, Teeswater, Wensleydale, or Blue-faced Leicester, to produce Halfbreds, Greyfaces, Mashams, etc. — commercial crossbred ewes which are in turn crossed with Down rams for lamb production on lowland farms. In addition to this, there are a number of breeds which are normally run as self-contained flocks

producing their own replacements, some female stock for sale and fat wether lambs. Examples are the Clun Forest, the Kerry Hill and Romney Marsh breeds.

From a genetic point of view, this pattern of stratification and crossbreeding has several advantages. In the first place, it results in a considerable economy of effort. The hill breeder, for example, can devote his efforts to the improvement of hardiness, ability to rear an adequate lamb crop and to produce a fleece of adequate quality and weight. He need pay little attention to carcass quality and growth rate. On the other hand, in the flocks producing the sires of crossbred ewes (*e.g.*, Border Leicester flocks), efforts can be concentrated on improving prolificacy, milking ability and growth rate, while, in the flock producing fat lamb sires, the objectives in improvement are limited to increasing growth rate and carcass quality. Since progress in improving a breed is very greatly affected by the number of characters which have to be considered in a breeding programme, this specialization of function has a very substantial advantage. Secondly, the pattern of breed crossing makes use of any hybrid vigour that may be involved in the crosses. Here is an application of a broad principle which has become clear in recent years. Characters of the animal which are closely connected with its reproductive ability are generally poorly heritable and thus difficult to improve by selection and are subject to degeneration under inbreeding. However, these characters also generally show hybrid vigour in crosses. Thus, in the crossing of the Border Leicester type of sire to the hill ewe to produce crossbred ewes, best use is being made of hybrid vigour in improving prolificacy and mothering ability.

Perhaps the most vulnerable aspect of this scheme is that it is very strongly dependent on the supply of hill ewes for its maintenance. In the main, the hill ewe stocks are subject to heavier losses during severe winters than lowland flocks. Also, if the level of prices falls, land used for grazing hill flocks may be more profitably devoted to forestry. This again would reduce the supply of draft hill ewes. Apart from these considerations, there is, however, little doubt that the pattern of stratification and crossing which has developed is sound.

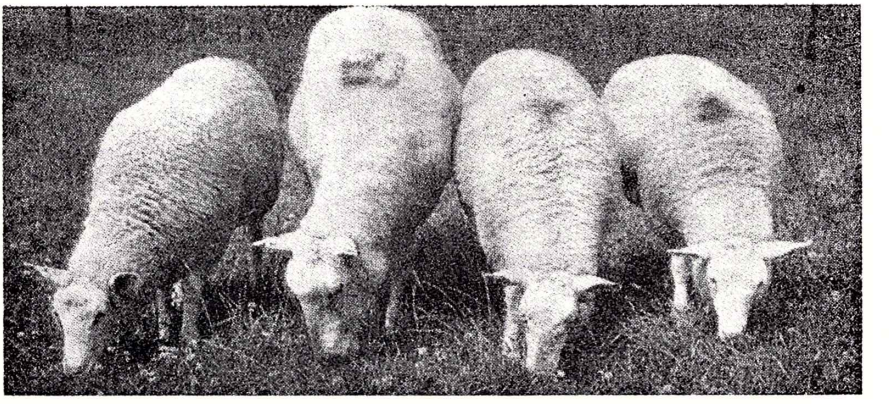
It is interesting to note in passing that one of the newest agricultural industries in Britain — the broiler chicken industry — has utilized essentially the same principle of

specialization. Most broiler chicks sold are three-way crosses — *i.e.*, they are a cross between a sire line selected almost entirely for growth rate and carcass conformation, and a female which is herself a cross between two lines in order to obtain any hybrid vigour in egg production.

In a sheep industry with such a wide variety of breeds and types of farming, it is to be expected that the relative financial returns from lamb and wool will vary widely. Surveys carried out by various universities indicate that the value of wool in lowland flocks comprises only about 10 to 15% of the income from sheep; that for upland farms (mainly producing crossbred ewes) it is about 15%; and that on hill farms in Wales and Scotland, it ranges between 25 and 45%, depending on the type of country. Thus, despite the fact that returns from wool have been good in recent years, the production of lambs is still of overwhelming importance. Thus, the level of prolificacy of sheep breeds is the most economically important characteristic.

The British farmer's idea of what constitutes a satisfactory level of lamb production is far in advance of that commonly held in New Zealand. More important, however, is the fact that many British farmers are far from satisfied with the average of 150 to 180% of lambs reared, which is normal under lowland conditions. Consequently, several important breeding projects are directed towards raising lambing percentages to levels which most New Zealand farmers would regard as "fantastic".

As mentioned earlier, one of the types of breeding ewe most commonly used for fat lamb production is the result of crossing Border Leicester rams with the Cheviot ewes (to give the Scottish Halfbred) or the Scottish Blackface ewes (to give the Greyface). Some doubt has arisen as to whether the Border Leicester is inherently fertile enough for this purpose. One project, which is of outstanding interest, has as its objective the development of a breed which will be able to pass to its offspring greater fertility, milk production and mothering ability, than does the Border Leicester. This project is being undertaken by a breeder, Oscar Colburn, of Crickley Barrow, Northleach, Gloucestershire. The Colbred — as the breed is called — is derived from crosses of four breeds — the Border Leicester, Clun Forest, Dorset Horn and the East Friesland Milk Sheep. The last-named breed was specially imported from Holland by Mr Colburn and is notable for its very high fertility and milk production. As its name implies, it is used for milk production in its country of origin. Sheep of



Colbred ewe and triplet lambs.

the fifth generation from the original crosses have now been bred and their production and general appearance give every indication that the experiment has been successful. A further indication of this is a recent newspaper report that a Colbred ram had been sold at the price of £5,000. A breed society has been formed and the future for the breed appears good.

Another indication of the concern in Britain to increase further the level of lamb production is given by the recent importation of the Finnish variety of the Romanoff breed. This breed normally produces and rears 3 to 4 lambs at each lambing. It is probably the most prolific breed of sheep available at present, this point being highlighted by the fact that one of the rams imported into Great Britain was from a litter of seven lambs. The importation was made by the Animal Breeding Research Organisation, Edinburgh, with the intention of investigating whether its high prolificacy can be utilized in crossing to improve British breeds.

Crosses of various British breeds are also being investigated, again in most cases with the objective of improving fertility. For example, a group of breeders in Kent has started to cross the Romney Marsh with the North Country Cheviot in order to produce a more prolific sheep which will still retain some of the adaptation of the Romney to the conditions of farming in the area. In effect, they are setting out to produce a Kentish variant of the Perendale. There is much interest, too, among hill-sheep farmers in Scotland and the North of England in the recent demonstration of

hybrid vigour in crosses of the Swaledale and the Scottish Blackface in an experiment carried out by the Animal Breeding Research Organisation. The increased production of the cross came from a slightly greater number of lambs with better ability to survive and to grow and from slightly greater wool production. There is much talk of the use of a three-breed rotational crossbreeding scheme for hill sheep but there is little evidence available of the efficiency of this scheme.

Performance and Progeny Testing of Sheep in Britain

There is much interest in Great Britain among the more advanced sheep breeders in sheep recording, performance testing and progeny testing. Much of this interest has been stimulated by a report of a Committee on Sheep Recording and Progeny Testing under the chairmanship of I. R. Morris (published by H.M.S.O., London, 1961). The importance of this subject was also stressed by the Livestock Breeding Conference organized by the National Agricultural Advisory Service last year.

Recording the production of the individual animal is fundamental to any breeding programme. The problem of what to record naturally differs from breed to breed and is basically determined by the objectives of improvement in the particular breed as outlined in general terms earlier in this paper. Clearly, to record but not to use the records as a guide to selection is a waste of effort.

Recording of prolificacy, liveweights and fleece weights of individual sheep in stud flocks, presents no particular difficulties. There are, however, unresolved problems in recording carcass quality and growth rate in breeds being used as fat lamb sires. The Report comments: "In the past a great deal has been done to modify conformation, and thereby the shape of the carcass, by selecting breeding stock by eye. It seems doubtful whether much of significance remains to be done in this way unless techniques are devised to reveal what at present only the carcass can show, e.g., the amount of fat and the size of muscles". It stresses the need for the development of objective standards of carcass excellence for use in breeding programmes. This is a difficult problem and it is true to say that nowhere has it been adequately solved.

The difficulty with early growth rate in a breed being bred for siring lambs to be slaughtered prior to or soon

after weaning is not of measurement but of interpretation. Growth up to weaning is very largely controlled, not by the inherent ability of the lamb, but by the milk supply of the ewe. Thus, in selecting a ram with a good growth rate to weaning, one may be selecting only for the dam's milking ability and not for high growth rate. If this is a real problem, then it may be necessary to wean the ram lambs soon after birth and rear them artificially to obtain a meaningful performance test. Some work on this aspect, which is important in breeding the sire for lamb production, is being carried out in Britain.

Several sheep recording schemes are in operation in Great Britain. The oldest — the Oxford Stud Sheep Health and Improvement Scheme — has largely concentrated on health and there is no evidence to show that it has led to genetic improvement in the flocks concerned. The two other schemes — one organized by the National Sheep Breeders' Association and the *Farmer and Stockbreeder*, and the other by the Ministry of Agriculture, Fisheries and Food — have been in operation for only a short time. In general, it seems that the climate of opinion in the sheep industry generally is such that a nation-wide scheme under a central authority is likely to be formed in the near future.

The Committee also recommended the more widespread adoption of progeny and family testing for lowly heritable characters, even though it recognized the difficulties in implementing this where flocks are predominantly small in size. A good example of this is the progeny testing project with Clun Forest sheep being carried out under the direction of Professor M. M. Cooper at Durham University. The production target is an average of two lambs per ewe, killing out at 38 lb carcass weight at 12 weeks of age off grass. The flock consists of 600 ewes. The ram lambs with the best growth rate are test-mated with the younger ewes of the flock. On the basis of the growth rate and carcass quality of their progeny, the best rams (now two-tooths) are chosen and used on the older and better ewes which form a nucleus for the flock and provide the next crop of ram lambs for testing. A more complicated testing plan, which puts greater emphasis on the prolificacy and milking ability of the ewe, is being carried out with Clun Forest sheep by Mr Colburn, who was mentioned earlier as the founder of the Colbred.

Brief Comment on Sheep Breeding in Some European Countries

In European countries generally, the sheep industries are not of major importance (with perhaps the exception of Spain). Sheep meat constitutes an unimportant part of the meat diet and often conditions are not good for sheep farming. Consequently, one would expect to find little of interest in sheep breeding on the Continent. This expectation, while probably true in the past, is no longer so. Space permits mentioning only a few examples.

In France, the increasing demand for Rocquefort cheese, which is made from ewes' milk, has stimulated interest in setting up a modern programme for breeding better milking ewes. The programme calls for extensive recording of milk production of ewes (last year 30,000 ewes were recorded) and the selection of rams on progeny test or pedigree for milk production, following very much the pattern established for progeny testing dairy cattle. The milk records are analysed at the Institute for Animal Genetics in Paris. Modern machine milking parlours have been introduced and overall efficiency of the industry is being greatly improved.

In another breeding programme which is being carried out by the Institute of Genetics in Paris, attention is being given to growth rate and carcass quality which are economically the most important traits in most French breeds. Liveweight records of lambs from birth to weaning are collected on the farms of co-operating breeders, are analysed at the Institute, and the results returned to the breeder for use in selection. Again, last year about 30,000 lambs were included in the programme. A similar programme for measuring wool characters is being run on a more limited scale for wool breeds. The extent of this work on sheep and the results being achieved were most impressive and it is clear that French sheep breeding and agriculture generally will be a force to be reckoned with in the future.

Beef Cattle Breeding in Great Britain

It is probably true to say that, as far as the New Zealand beef cattle breeder is concerned, the focus of interest in British beef breeding has been the Perth Sale with its prize-winners and its record prices for bulls sold at auction. The compact, overfat type of animal which has topped the market at this sale, largely as a result of demand from

overseas buyers, has dominated the objectives of the British cattle breeder. The occasional high prices paid for bulls for export have blinded the breeders to the fact that this is a comparatively rare event and that the export trade represents only a very small proportion of their total trade. The importation of the Charollais breed and the popularity of the Friesian are indications that the beef cattle breeders have failed to meet the requirements of the commercial producers. There are many signs that this situation is being realized and that important developments will take place in the near future.

In contrast to New Zealand, U.S.A., Australia and the Argentine, the beef industry in Britain is based less on special-purpose beef breeding herds than it is on the dairy industry. It appears that about 70% of the cattle slaughtered are out of dairy cows and only 30% are out of beef cows. It is estimated that about 30% of the cattle bred from dairy cows are by beef bulls, the Hereford being the most popular breed. As far as calves from beef cows are concerned, they are usually born in the early spring and sold as weaners in the autumn at 7 to 9 months of age. The calves born in dairy herds are reared on either milk or milk substitute — mainly the latter. Early weaning at five weeks of age is becoming a common practice. Cattle are finished for slaughter either on pasture or in fattening yards. It has recently been shown that it is possible and economic to feed cattle a no-roughage ration which is 85% crushed barley plus protein concentrate, minerals, etc. On this ration they reach a liveweight of 850 to 1,100 lb in 12 to 13 months. Pure beef breeds get too fat under this feeding method and Friesians are regarded as the best breed for this form of production. There is considerable interest in this method, and its development along the lines of large-scale feed-lots in the American manner is taking place.

From the viewpoint of commercial production, the objectives in beef breeding are not so very different from those required in New Zealand. They are:

(1) Better growth rate and economy of food use.

(2) Carcass quality.

(3) Fertility and mothering ability.

(4) In some breeds, such as the Galloway and the Highland, adaptation to poor environments.

Since 1957, there has been a very considerable amount of work on performance and progeny testing of beef bulls. This work has taken two general forms:

TESTING AT SPECIAL STATIONS

In 1957, the Ministry of Agriculture, Fisheries and Food started a test with 10 Hereford bull calves, the test lasting until the age of one year. This test has been repeated on 10 new bulls each year from 1958 to 1960. Each year all the performance-tested bulls are progeny tested by mating to Friesian cows (by A.I.) and 12 steer progeny per bull are reared to 18 months. This allows an assessment of the accuracy of the rate of gain test in predicting the breeding value of the bull. Preliminary indications are that it is high.

A project, similar in general principle, has also been carried out at Barlby Farm in Yorkshire by British Oil & Cake Mills. They have tested Beef Shorthorns, Aberdeen Angus, Hereford and Devon bulls. In this case, however, the amount of progeny testing has been limited, only the best and worst bulls on performance test being subjected to a progeny test.

At the North of Scotland College of Agriculture, Shorthorn and Aberdeen Angus bulls have been performance tested and a number of them are being progeny tested. Teams of Hereford and Aberdeen Angus bulls have been performance tested by the Milk Marketing Board and they are also being progeny tested.

RECORDING ON PRIVATE FARMS

In addition to these experimental station tests, many organizations are weighing cattle on farms either as a bull progeny or performance test, or as an aid to the commercial fattener. In 1961, the Aberdeen Angus, Lincoln Red and Sussex Breed Societies started performance testing schemes for pedigree bulls, while the West of Scotland Agricultural College is weighing cattle in a series of co-operating herds (mainly Galloway). The Milk Marketing Board has several travelling weighbridges at work in dairy herds.

This work, both on farms and at testing stations, has been of great value in promoting the technique and in investigating some of the basic problems. By no means all of the problems have been solved. The station tests have suffered from a lack of standardization. Whether tests should be based on a standard age or a standard weight

Performance testing in Britain is recorded on private farms as well as at testing stations.

range needs to be further investigated. Ways of overcoming differences in pre-test environment need to be finalized. Age at completion of the test also needs consideration. Most of the British tests have finished at 12 to 14 months of age. On the other hand, their commercial offspring will not normally be slaughtered till 18 to 27 months of age. But results available already show that the principle is sound.

In current thinking in Britain, performance testing is regarded as only a first screening of potential sires for use in pedigree herds or for use in artificial insemination for commercial beef production. The ultimate choice is to be based on progeny testing, especially for those characters which can only be assessed on the carcass. In this, a number of difficulties need to be overcome.

First, more information is needed on what constitutes carcass quality and how it can be measured. Until this is solved, there is little point in large-scale progeny testing.

Secondly, in all the beef breeds, the herds are typically small. For example, in the two principal breeds, the Hereford and Aberdeen Angus, less than four females on average are registered per herd per year. Thus the individual beef

breeder has no chance of comparing different bulls in his own herd nor any way of comparing the performance of bulls in different herds. In these circumstances, the logical method of progeny testing would be the use of some form of contemporary comparison similar to that in the dairy industry whereby a number of promising bulls (as assessed by performance testing) produce offspring for test in many herds. The only way in which this can be done is by artificial insemination. This is not permitted for pedigree cattle at present though it can be used for progeny tests on non-pedigree cattle. It is clear that, if beef breeders are to enjoy the benefits of progeny testing, there is need for close collaboration between breeders and a need to re-examine their attitude to artificial insemination as a tool for breed improvement.

In this connection, there are a number of significant developments taking place in Britain that suggest a determined endeavour to use performance testing and progeny testing in beef improvement. Last year, the Royal Agricultural Society of England decided to use its permanent showground site as a station for performance testing work during the 10 months of the year in which it is not in use. It is likely that other show societies will follow this lead. More recently, the Milk Marketing Board of England and Wales has decided to set up a large-scale progeny-testing station for testing beef bulls. The Board is probably the biggest purchaser of beef bulls (mainly Hereford) for use in artificial insemination. As mentioned earlier, they have undertaken some progeny testing using portable weigh-bridges. This new project will result in a more accurate and efficient testing procedure. It also appears likely that some form of central authority will be formed in the near future to develop and integrate work on beef recording, station performance testing and progeny testing.

Performance and Progeny Testing in Other Countries

In this paper, attention has been concentrated on the developments in beef breeding in Great Britain, since these are perhaps of most direct interest in New Zealand. However, performance testing originated in U.S.A. and is now being widely applied in that country and Canada. In U.S.A., some 35 experiment stations are involved in carrying out performance testing with bulls, some 600 to 800 being tested annually. In addition, performance testing on a within-herd basis is being practised by well over 4,000

breeders. In the last year, both the American Angus and Hereford Societies have inaugurated progeny-test programmes to supplement performance testing.

The same general picture is found in European countries. In these countries, there are few specialized meat breeds, most of the cattle being dual-purpose in type. In these cases, progeny testing for beef production is simply carried out as part of the normal testing of young bulls for use in artificial insemination. Much useful work is being undertaken there on carcass and meat quality.

The Charollais Breed

In recent years, no other breed has attracted as much attention as the French Charollais cattle, and there are now very few beef-producing countries where it is not being tried out. It is one of the few breeds in Europe which has been bred essentially for meat production. It has rapid growth rate and produces a very lean carcass, and in many ways seems ideal for modern beef production. Charollais bulls were imported into Britain in 1961 and an extensive series of crosses have been made through artificial insemination for comparison with crosses by other breeds. The tests being carried out are arranged at three levels: (1) Tests in which individual feeding and thorough carcass evaluation are carried out; (2) Tests on institutional farms where only growth and commercial carcass evaluation can be carried out; (3) On-farm tests arranged by the Milk Marketing Board.

Some of the important questions to be answered are:

(1) Is the Charollais able to improve the beef production of the Ayrshire breed? The Ayrshire is the most important milk breed in Scotland and, thus far, no cross of a beef bull on to the Ayrshire has been found entirely satisfactory for beef production.

(2) How does the Charollais × Friesian compare with the pure Friesian which is already known to produce satisfactory beef and to have rather better growth than the recognized beef breeds?

(3) It the Charollais cross a better feed converter than the Friesian?

(4) What is the incidence of calving troubles in the Charollais cross? This is an important question. In the pure Charollais, the incidence is high (up to 30% in heifers). In

this connection, there is some information from European countries. The results are somewhat unexpected. For example, in Denmark, the Charollais crossed to the Jersey gives very little trouble, whereas, when it is crossed to the very much larger Red Danish breed, there is a much higher incidence of calving trouble. A similar situation seems to occur in Sweden where there is little trouble with the small White Mountain cattle but a high incidence with the larger Swedish Red and White cattle.

An interesting point about the Charollais is that within the breed there is a quite high incidence of a condition known as "double muscling" or "muscular hypertrophy". The condition gives rise to an excessive development of muscle, especially in the leg, reduction in the amount of fat (particularly subcutaneous fat), thin skin and light bone. The condition is inherited and in its extreme development leads to difficulties at birth and higher mortality at later ages. It is of interest, however, in that it may be an advantage from the butcher's viewpoint because of greater muscle and less fat. Because of this, a detailed investigation of this character is being undertaken in France.

Conclusions

It is now appropriate to point out from this brief survey the conclusions which are important to sheep and beef cattle breeding in New Zealand. In this paper, attention has been concentrated on the practical things that are being done by breeders or breeders' organizations rather than on discussion of specific research projects. All of them are soundly based on the genetic principles involved and it is worth while stating these explicitly.

It must be remembered that it is really only in the last 15 to 20 years that a consistent and useful theory of animal breeding has been available. Stripped of all its complexities, this theory states a few simple points. First, the objective in improvement must be as simple as possible and it must be pertinent. It must be simple in the sense that breeding for characters which have little or no economic importance merely makes the job more difficult. It must be pertinent in the sense that the characters bred for are those required by the commercial producer and the ultimate consumer.

Secondly, it is necessary to measure and record the characters which one wishes to change and to use these measurements as the basis of the breeding plan.

Thirdly, where the characters to be improved are highly heritable, individual selection alone is required. Where they are lowly heritable or can be measured only in one sex or only after slaughter, some form of progeny testing or family selection is needed.

There is a fourth point that is implicit in earlier discussion of breeding plans but is often not noted. Animal breeding theory states, in effect, that breeding has a very large element of chance in it. This, of course, has been known for a very long time. What is overlooked, however, is the answer to this difficulty. It is that the breeding unit has to be sufficiently large so that enough animals can be tested to give reasonable certainty of a regular supply of good ones. In other words, some sort of organization is required in order to achieve the advantages of size, to undertake recording, and to supply the services required.

It is of interest to note what has happened in other industries. The most spectacular changes have occurred in the poultry industry. In U.S.A. and Britain, the supply of day-old chicks is no longer in the hands of thousands of small breeders working on traditional lines with conventional breeds and crosses but is mainly controlled by a half-dozen large concerns each selling many millions of chicks annually. A small body of geneticists, employed by these firms, now controls the breeding of the majority of birds used for either meat or egg production. To be successful, the breeding units have to be large because they have to support a heavy overhead in facilities, electronic computers and, most important of all, trained poultry geneticists and the research which they carry out. As an example to show that these methods may well be applicable to other species, Thornber Bros Ltd. of Mytholmroyd, Yorkshire — the largest poultry breeders in Britain — have started to investigate the possibility that the large-scale methods used in poultry breeding can be applied to sheep breeding. Initially, they are concerned with the breeding of the fat-lamb sire and with the production of a standard quality lamb carcass. Basically, the approach is to apply scientific breeding methods on a large scale towards improving those traits which are economically important.

Another approach is to set up an industry authority, or central organization, to supply the services required to the individual breeder. This has been the typical method in most dairy industries and appears to be the likely approach for beef cattle and sheep breeding in Britain. In other cases,

formation of co-operating groups or of companies has been used to achieve size. Examples of this occur at present in the poultry breeding industry in Australia, New Zealand, Britain and the Continent. Cattle Breeders' Service is an example in dairy cattle breeding in Britain. Space does not permit a full assessment of these methods and it may well be that more than one method is required in the sheep and beef cattle industries of New Zealand. It is abundantly clear, however, that the traditional art of breeding is no longer adequate as a means of livestock improvement, that the individual breeder can no longer be self-sufficient and that, as a consequence, some form of organization to make use of modern methods is necessary. The fact that this is taking place in Britain, where the traditional art of breeding has been raised to a very high level, should be sufficient warning that there is urgency if New Zealand is to keep up with progress being made in other countries.

DISCUSSION

Q:: *In the case of the Romanoff breed, were all the lambs hand-reared?*

A:: As I understand the position, it is usual for the ewe to rear up to four lambs. The remainder are presumably hand-reared.

Q:: *To what extent do difference in breed, standard of shepherding and size of flock contribute to the higher lambing percentages in Great Britain?*

A:: Clearly all these factors contribute. It must be noted, however, that many stud flocks in New Zealand are comparable in size and in standard of shepherding to many of the flocks reported in the National Lambing Competition in Great Britain. The fact that the results achieved in these competitions are very much higher than in New Zealand suggests that differences in breed play an important part.

Q:: *Can the Romanoff breed be imported into New Zealand and, if so, how should they be used?*

A:: I understand that the Romanoff breed cannot be imported at present. Quite a lot of investigation would be required to decide how best to use it in New Zealand. One possible way would be to use it as one breed in a three- or four-breed cross.

Q:: *What progress has been made in combating scrapie, the disease which is responsible for the restriction on importation of sheep from Great Britain?*

A:: A considerable amount of research on scrapie is being undertaken but no solution is yet available.

THE DRAINING OF FARM LANDS

(Revised 2nd edition, 1962)

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In his foreword to this book, Sir Geoffrey Peren writes:" . . . this publication should be of considerable help to those who are considering the drainage of their properties. It makes available in a handy form all existing technical knowledge of land drainage — the results of research both at the College and overseas, as well as the wide experience in the field for many years of the College Drainage Extension Service. I commend it to all who have country which needs draining".

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